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The index is compiled by Miss M. L. Yeo

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ERRATA

- p. 3, l. 10: 7 for 6; l. 12: 133 for 132; l. 33: 16 Assistant-Teachers, 6 Paid Student-Teachers for 18 Paid Student-Teachers.
- * 5, " 15-16: in the working of small holdings for work in the plots attached to the Agricultural Schools.
- " 7, " 17: about 1500 sq. yards for 500.
- " 8, " 33: 130 000 for 100 000.
- " 11, " 8. 3rd for 30.
- " 12, " 15: 1 500 000 Kroner for 500 000

ORIGINAL ARTICLES

AGRICULTURAL EDUCATION IN NORWAY

For the better understanding of the subject here treated, it is worth while to give a few notes on the general position of agriculture in Norway.

Norway covers a large number of degrees of latitude (58-71° of Northern lat.) and being an extremely mountainous country, large areas of agricultural land are only to be found here and there. As a rule the agricultural land lies at the foot of the valleys and along the fiords and coast-line, and since large-scale farming is practically an impossibility, Norway is pre-eminently a country of small farms.

The number of inhabitants is 2 650 000 of whom 40 % or roughly 1 million are engaged in agriculture though a considerable proportion follow also subsidiary occupations. The area of the country is about 124 445 sq. m., 70 % consisting of unproductive land, lakes among the mountains etc., except in so far as some part of the large uncultivated area is utilized as pasture during the summer. Of the remaining 30 %, just over 27 000 sq. m. are forests and pastures; about 4000 sq. m. cultivated land and meadows, farms only covering some 1400 sq. m. of this area. Speaking generally the quality of the soil is good and its productivity is relatively high, while as regards wheat, Norway is amongst the European countries which can show the highest yield per acre. The yield of potatoes and hay per unit of area is higher in Norway than in any other country.

Elementary education is widespread and the elementary schools though essentially democratic, provide a complete form of instruction, capable of serving as a base for further education. Most of the children attend the compulsory elementary school, in which the course lasts for 7 years, and they are taught Reading, Writing and Arithmetic as well as given a general knowledge of History, Geography, Zoology, etc. Only a small minority are instructed in private schools.

A number of continuation schools are attached to the primary schools and are called "Young People's Schools" or "People's Secondary Schools". Most of the peasants attend these schools after completing their course in the elementary schools.

The Norwegian peasant is very fond of reading and is much interested in politics. Generally he is a subscriber to several newspapers and frequently also to special periodicals. The telephone which is now found on almost every farm, keeps him in communication with the most distant parts of the country as well as with the larger centres of culture.

As already stated, agricultural properties are divided into small holdings, which require an intensive cultivation in order that they may give satisfactory results; hence it may be said that skill becomes a matter of necessity and this fact is undoubtedly the reason why in Norway agricultural education is much more highly diffused and developed than the natural conditions of the country would lead one to expect.

The first school of agriculture was founded in 1825 by JACOB SVERDRUP, a member of the Academy, and from 1840 to 1850 practically each province had a school of its own. In 1859 the Higher School of Agriculture was established. The country people however did not realize at its true value the importance of specialised instruction and, as at this period there was a strong spirit of economy prevalent throughout the country, a reaction very shortly arose. At the same time it has to be admitted that the instruction in agriculture, which was entirely of a theoretical character, was not well adapted to the requirements of practical life and hence for the period from 1865 to 1880 there were very few schools actually at work.

From 1885 onwards a new start was made with the establishment of the schools, but it was not till 1892, when the Storting decided that $\frac{3}{4}$ of the cost should be met by the State, that agricultural education showed any really considerable development. At the present

time Norway possesses agricultural schools which make a special feature of the following subjects : Agriculture, Horticulture, Dairying, Forestry and Household Management.

The schools may be divided into 2 main classes :

A) *Higher Schools for the Training of Teachers and Technical Instruction, Higher School of Agriculture, State School for Instructors in Small Farm Management, State School for Household Management Mistresses.*

B) *Schools essentially practical in character : 34 Agricultural Schools, 6 Small Farm Management Schools, 9 Schools of Horticulture, 5 Schools of Dairying, 10 Schools of Forestry, 68 Household Management Schools. In all 132 Schools.*

Three of these schools are situated within the Northern Polar circle, and the most northerly is between 70 and 71 degrees of Northern latitude. All the schools named are under the control of the Department of Agriculture, whereas speaking generally other forms of public education are under the purview of the Education Department.

THE HIGHER SCHOOL OF AGRICULTURE.

This School has 5 separate departments for Agriculture, Forestry, Horticulture, Dairying, Land Surveying and Valuation respectively. The courses last for 3 years and are open to women as well as to men, though up to the present there have been but few women students. The total number of students is from 200 to 250.

Instruction is given in the form of lectures followed by practical work. The total number of lectures given in each department is about 2500, while 750 hours in all are given to practical work. The staff of the Higher Agricultural School is as follows :

20 Staff Lecturers from whom the Director is chosen, who holds office for 3 years ;

7 Special Lecturers ;

2 Itinerant Instructors ;

18 Paid Student-Teachers and about 20 other officials.

In this total is not included the staff required for administration and the work of the farm, which has an area of about 60 acres made up of agricultural and forest land.

For admission to the school each candidate must have done practical work on a farm for 2 years, or 3 in the case of Horticulture ; he

must hold the certificate of a Secondary Agricultural School as well as the School-Leaving certificate. In special cases persons may also be admitted who can show that they have an adequate knowledge of German, English, Norwegian, Mathematics, etc.

Special 1 year preparatory courses have been established by the Ministry of Agriculture to provide for these special cases. It follows therefore that in order to obtain the diploma of the *Higher Agricultural School* 8 years of instruction are necessary, namely:—

- 6 Months in a Secondary School.
- 2 Years practical work.
- 1 ½ Years in a Secondary Agricultural School.
- 1 Year's preparatory course.
- 3 Years in the Higher School of Agriculture.
- Total 8 years.

18 additional months must be reckoned to include the period necessary for obtaining the School-Leaving certificate. In addition to the instruction in theory given in the school itself, special attention is paid to agricultural experiment, including work in connection with the cultivation of crops, wheat production, methods of agriculture, injurious plants, cattle feeding and raising, agricultural machinery, horticulture, soil analysis (physical, mechanical, chemical and geological), forestry methods etc.

The annual net estimate of expenditure for the School is 950 000 kroner.

The organization of Higher Agricultural Education in Norway differs from that in the majority of other countries by the fact that it is very closely associated with the Secondary Schools of which it may be regarded as a direct continuation. This system which involves a close relationship between the Secondary Schools and the Higher Agricultural School, keeps the latter in direct contact with practical agriculture. Candidates for admission to the Higher School, of whom the majority are of the peasant class, have received in the Secondary Schools a form of instruction adapted to the conditions prevailing in their native districts, and for this reason agricultural education in Norway does not present the same uniformity which is to be found in the majority of other countries, a fact which is of extreme importance in a country where agricultural conditions are so varied.

Under the system of agricultural instruction which is in vogue

in Norway, students are submitted to a process of selection in the Secondary Schools and thus only the best are admitted to the Higher Schools. A candidate cannot truly estimate his real aptitude except in these schools, and it often happens that candidates, who originally thought that they had the necessary capacity, are obliged to withdraw. Moreover, it is very difficult for a candidate, who cannot show a satisfactory certificate from the Elementary School, to obtain admission to the Higher School. The Secondary School, while providing courses which are preparatory for the Higher School, at the same time undertakes preparation for practical work in agriculture, forestry etc. Instruction is of a uniform character only for such subjects as are entirely independent of circumstances.

STATE SCHOOL FOR THE TRAINING OF INSTRUCTORS
IN SMALL FARM MANAGEMENT.

This school was founded in 1914 to train instructors for work in the trial-plots attached to the Agricultural Schools and for the itinerant lectureships in different districts. The staff is as follows:—

- 1 Director.
- 2 Special Lecturers.
- 3 Lecturers.
- 2 Demonstrators.
- 2 Paid Student-Teachers.

In addition there are the staff and labourers required for the working of the trial-plot.

40 pupils may be entered each year, and for admission the necessary qualifications are 2 years of practical work as well as the certificate of a Secondary Agricultural School. The period of instruction required for the Training course is as follows:—

- 6 Months in the Continuation School.
- 2 Years practical work.
- 18 Months in a Secondary Agricultural or Horticultural School.
- 2 Years in the Training College for Instructors in Small Farm Management.
- Total 6 years.

The annual budget of expenditure shows a total of about 70 000 kroner.

Instruction is given partly by means of lectures followed by practical work and partly by making the student take a direct share in the

agricultural work of the School. The number of lectures given is about 1800 with 670 periods of practical work.

The School was founded to encourage the development of small farming. In Norway, most of the farms have so little agricultural land that they are scarcely sufficient for the support of a family, unless special attention is given to the development of the minor subsidiary industries. The farm must support a large number of domestic animals, especially small stock such as for example, pigs, sheep, goats, poultry, rabbits and bees. The land must be used chiefly as vegetable garden which requires much hard work, but gives excellent results, especially with herbs, potatoes, fruit-trees and vegetables. The study of household industries is also included in the curriculum of the school.

STATE TRAINING COLLEGE FOR TEACHERS
OF HOUSEHOLD MANAGEMENT.

The object of this college is the training of mistresses for schools of Household Management and for giving cookery instruction in elementary schools. It is divided into 3 departments :

A) *The Training School* for Teachers of Household Management with a 2 years course.

B) *The Training School* for Cookery Teachers in Elementary Schools with a 1 year course.

C) *The Household Management School* with alternative courses of 6 months and of 1 year.

This last section may be considered as a preparation for the Household Management Training Course. Candidates for admission to the Household Management Training Course must have attended an Elementary School of Household Management and possess a good general education and have taken for instance 2 winter courses in a Continuation School. For admission to the Cookery Training Course the Elementary Teacher's certificate is required. For admission to the Household Management School a sufficient elementary standard of general knowledge and at least 1 year's practical household work are the only necessary qualifications. The period of instruction for Teachers of Household Management therefore includes :

1 Year in the Continuation School.

1 Year's practical work.

6 Months in the School of Household Management.

2 Years in the Training College for Teachers of Household Management.

Total 4 ½ Years.

The period of instruction for a Cookery Teacher covers :—

6 Months in a Continuation School.

3 Years in a Teachers' Training College.

1 Year in the Household Management Training College.

Total 4 ½ Years.

The staff of the school is as follows :—

1 Woman Principal.

6 Subject Teachers.

2 Assistant Subject Teachers.

3 Paid Student-Teachers etc.

The annual estimate of expenditure is about 145 000 kroner.

At the present time an addition is about to be made to the school of a building covering an area of about 500 sq. yards, which will cost about 2 million kroner. A house of residence with moderate charges is attached to the three colleges above described, maintained at the expense of the State. As a large number of scholarships are provided the actual cost of residence is very low. All the teaching is free.

SECONDARY SCHOOLS OF AGRICULTURE AND SCHOOLS FOR SMALL FARMERS.

Most of these schools are maintained by the province, others are aided by the rural communes or private societies. Only a few private schools are in receipt of State aid.

The State provides three quarters of the expenditure for Staff, Scholarships, Scientific Apparatus, Medical Attendance of students, Travelling Expenses etc. The remaining quarter is as a rule found by the province. The Body responsible for the upkeep of the School, generally the Provincial Administration, is bound to provide the site and equipment and also in certain cases to undertake at its own risk the working of the farm. Most of the Schools have a Hostel, the province being responsible for the expenditure. In most of the Schools of Agriculture the theoretical courses are given in two winter sessions, the practical work being taken during the corresponding sum-

mer periods, either on the school farm or on farms in private ownership recognized for the purpose by the particular school.

Some schools have a combined theoretical and practical course lasting one year, in others the course covers 5 or 6 months but in such cases is purely theoretical. In addition to natural science and the elements of the theory of agriculture and stock raising, forestry, horticulture and dairying are also treated. Instruction is likewise given in Norwegian and mathematics though it is hoped that it may be possible to eliminate these subjects as soon as there are sufficient Continuation Schools to give the young peasants all the instruction required preliminary to entrance to an Agricultural School.

In the Schools with the 2-year winter courses in theory, the number of lectures is 1200 in addition to 300 lessons in experimental work and practical lessons apart from actual field work. Practical and experimental work have in the last few years been a conspicuous feature in agricultural education.

The more important Schools also possess workshops for training in craftsmanship, in which students learn carpentering, smith's work and machine repairing, and can thus become independent of workmen, whose service is relatively costly and difficult to obtain when required.

The number of students in a larger school ranges from 50 to 120 and the number of teachers from 5 to 10. In the better schools the scale of staffing is as follows:—

Director.

3 Lecturers on Agriculture and 1 each on Horticulture and Forestry.

Bailiff.

Chief Groom.

Master Blacksmith.

Master Carpenter.

According to the latest estimate the total value of the buildings of the larger schools is between 300 000 and 1 000 000 kroner. The annual expenditure per School is from 70 000 to 100 000 kroner. The annual contribution from the Treasury for the Agricultural School and Small Farmers Schools is reckoned at 1 ½ million kroner; and that of the province at half a million, thus giving a total of two million kroner. To this must be added the other charges which have to be met by the province for interest, maintenance, and the sinking fund for the capital expenditure on the buildings and furniture. The total amounts to a very considerable sum.

Attendance at these Schools is by no means a costly matter for the students, as all instruction is gratuitous and board is provided at cost price, which does not include maintenance charges. The Schools have also considerable sums to spend on Exhibitions of which the monthly value per pupil may be reckoned at 40 kroner or about half the cost of boarding. Three quarters of these funds are provided by the State and the remaining quarter by the province. In cases of necessity, free board is provided at the School as also a sum for the purchase of books. Hence there is hardly any case of a farmer's son who has to forego an agricultural education for economic reasons.

Applications for admission are now so largely and continuously on the increase that of late the number of available school places has been insufficient.

Apart from this system of established Schools with fixed courses, which is naturally costly, there has been a very considerable provision of short courses, either at the Schools themselves or by utilizing the services of the itinerant lecturers. These short courses are specially intended for farmers who would have great difficulty in taking up any long course of study. Special subjects only are handled and as far as possible in full detail.

The immediate aim of the authorities is the gradual development of a system of Agricultural Education which will secure that no one shall have charge of a farm who has not at least some knowledge of the theory of his calling.

SCHOOLS OF HORTICULTURE.

At the present time there 9 Schools of Horticulture in Norway, 5 of which are organized on lines similar to those of the larger Agricultural Schools as regards conditions of admission for students, the number of courses and practical instruction. These Schools which are divided into 3 sections, Floriculture etc. under glass, Garden planning and Construction, Vegetable and Kitchen garden work, are specially planned for the training of persons wishing to become professional gardeners or to obtain the qualifications for admission to the Higher Agricultural Schools.

The remaining Schools give an 8-12 months course and are intended for the training of students, who desire to take up gardening as a subsidiary occupation. Four of these schools are entirely

maintained by the State, $\frac{3}{4}$ of the cost of one provincial school is found by the State and there are 4 private Schools which are partially maintained by State grants. The annual charge upon the State amounts to 150 000 kroner.

SCHOOLS OF FORESTRY.

There are 4 State and 3 provincial Schools of Forestry, each providing a 1 year course, and 2 provincial Schools providing an 18 months course, covering 2 theoretical courses in the winter and a practical course in the summer.

The two last named Schools are attached to Agricultural Schools and organized on similar lines.

Each School of Forestry has access to one or more of the State or Semi-State forests which are utilized for the practical instruction. State aid is given to the provincial Schools of Forestry on the same lines as to the provincial Schools of Agriculture.

The annual charge on the State funds amounts approximately to 250 000 kroner while 25 000 kroner are provided by the provincial administration with the exception of the 2 provincial Schools with 18 an months course, which have the same privileges as the Agricultural School to which they are attached.

SCHOOLS OF DAIRYING.

All Schools of Dairying are under State control. One of them, which is specially devoted to the training of Dairying Instructors, provides a 2 Years apprenticeship course in Dairies under private ownership. After apprenticeship students are admitted to the Schools of Dairying for a course of study which is entirely theoretical. Instruction and board are provided free of charge. The School can accommodate 16 students, and women as well as men are eligible for admission. The staff of this school includes a Director, an Assistant Instructor and 2 part-time Instructors. The 4 other Schools of Dairying are intended only for the training of dairy maids and are attached to the large co-operative dairies. A year of practical work in a Dairy is required to qualify for admission. During the first year, students work for 6 hours in the day, and also receive practical instruction for 2 or 3 hours. The course is completed by a period of theoretical instruction lasting for three months.

Instruction and board are provided free of cost to the students, who do not however receive payment for their work in the Dairy.

The staff includes a Director and Instructor as well as the mistresses required for the practical work.

The State grants for the Dairying Schools amount to about 80 000 kroner.

SCHOOLS OF HOUSEHOLD MANAGEMENT.

There are 68 Schools of Household Management, 30 of which are rural and under provincial control, 14 urban and under the State, and 16 private schools, the majority of which are in the towns.

The rural and provincial schools of Household Management are supported by the State and Province respectively in the same way as the Agricultural Schools.

A certain number of these schools are attached either to Agricultural or Secondary Schools, though efforts are being increasingly made to place them on an independent footing. Practically all these schools have a Hostel.

The publicly provided town Schools belong to the Municipality and are assisted by the State on the same lines as the rural schools. As a rule these schools have no Hostel though the students take their meals at the schools once or twice a day.

Private Schools receive State grants on a scale lower than that of the Public Schools and under a different system of regulations.

The majority of the Household Management Schools give a five months' course, in others the course lasts for a year and a few have a three months' course only. The tendency of the rural Schools is to make the one year course the rule.

The chief subjects of instruction are the following:— Cookery, Household Management, Sewing, Gardening, Flower-growing, Care of Stock and Dairying, Marketing, Hygiene, Care of Children.

A similar programme is adopted for the Urban Schools with the omission of the subjects of Gardening and Care of Stock and Dairying.

The Household Management Schools lay chief stress on practical instruction and only two or three hours daily are given to theory.

The number of students in each course varies from 12 to 40. The annual State contribution for the Household Management Schools amounts to 800 000 kroner.

The total annual State expenditure is about 3 950 000 kroner while the Provincial subsidies provide a further sum of 725 000 kroner. Hence the total amount of public funds devoted annually to instruction in Household Management reaches 4 675 000 kroner.

The work of the schools is supplemented by the activities of all the officials of the State, Provinces and Municipalities, who in order to give as general a diffusion as possible of a knowledge of the principles of agriculture, horticulture and dairying, pay visits upon the request of individuals and give gratuitously all such information as may be required. Salaries and travelling expenses are in these cases defrayed entirely by the State though in the case of other officials half the cost falls on the State and the remaining half on the Municipality concerned. The total number of officials is 260 and their salaries and travelling expenses cost in all a sum of 500 000 kroner annually.

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Director General

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THE BACTERIOLOGY OF AGRICULTURAL SOIL AND ITS DIFFICULTIES AND FALLACIES

Investigations and experiments connected with agricultural soils are some of the most difficult tasks in bacteriology.

The great difficulty of analysis which requires the adoption of various methods for the determination, not only of the species which may be present, but also of the number of microbes, lies first in the uncertainty of even the most fundamental of these methods. It may happen for instance that in counting the number of micro-organisms, a change of method may produce a considerable variation in the results obtained. This uncertainty may arise from antagonism between the number and the species of the micro-organisms during their development on the cultural media, or may be due either to the inadequate means employed for the isolation of all the microbiological species and of certain species in particular, or to the lack of sensitiveness in the chemical methods adopted (especially the nitrometric) to show the reactions caused by the bacteria.

Experiments also present several difficulties, especially :--

- 1) the limited effect obtained by the direct introduction of bacteria into natural soil whether *in situ* or in pots. This is due to the fact that the new organism has to fight against so many types or millions of pre-existing micro-organisms, that its action is necessarily impeded, and all the more so, since it cannot be preceded and assisted by pasteurisation as is customary in the case of other substances with a very high bacterial content, such as milk, etc.;

- 2) the great difficulty in the absolute sterilisation of soil by heat, whether the autoclave, steam, or hot air, or direct heating over a fire are employed; -

- 3) even if sterilisation is successful it never leaves in the soil its primitive characters as regards constitution and properties. Owing to the great complexity of the chemico-physical structure of soils,

the presence of hydrosols that may be coagulated by heat, and of a circulating solution forming the actual medium on which the micro-organisms act, any method of sterilisation cannot fail to produce profound changes in such medium and may lead to misinterpretation of the results of any given experiments;

4) chemical sterilisation of the soil is accompanied by similar difficulties and does not give better results than heat sterilisation.

But soil bacteriology has also to reckon with other forms of error which are at present not easily resolved, such as errors in theory, as for example the universal mistake of attributing to a bacterium in the soil, only the properties and no others which that bacterium manifests *in vitro* after isolation. What right have we to make such an assumption either in regard to the nature or the degree of action? Has it been realised that fertile arable soil (I had almost said *living* soil), is a very different thing from a solution in a thermostat? In reality, the differences are so many that it is worth while setting out the more important. (See table, page 19).

It has been, in general, unhesitatingly assumed that a bacterium which shows certain properties *in vitro* is sure to exhibit them in the soil and that if certain qualities appear to be lacking *in vitro*, they will also be lacking in the soil!

It is worth considering what conclusions would be reached if this method of reasoning were applied to other cases. Suppose we knew nothing of alcoholic fermentation and were to isolate and grow on the usual media a *Saccharomyces apiculatus* taken from the soil (which is of course an impossibility), and study *in vitro* its properties, since *in vitro* alcoholic fermentation would be the chief chemical activity of the saccharomycete. Perhaps we should be led to believe that a similar process takes place in the soil.

No less fallacious are the arguments put forward in the study of soil processes like nitrification.

Here (for I wish to assume that the exclusively biological character of this process has been demonstrated without any possibility of doubt) we have fallen into the opposite error. All the results of experiments agree in showing that there are very few nitrogen-fixing micro-organisms present in the soil. In fact, we can only obtain them by special means and then only in a very limited number of cases. We do not, however, hesitate to attribute nitrogen fixation to the few bacteria which alone are able as far as we know to fix nitrogen *in vitro*. When we reflect that in order to induce a bacterium growing

Factors of the environment	Artificial solution	Natural agricultural soil
Nutritive factor	Easily absorbed artificial substances	Natural substances scarcely even comparable with artificial substances
Thermic factors	Constant	Variable from some degrees below zero to several above 0°
Optic factor	Complete darkness throughout experiment (kept in the thermostat) or only following the alternation of day and night with uniform distribution throughout the mass (kept in surrounding air)	Light penetrating a medium and gradually losing its power during the day darkness during the night or starlight
Respiratory factor	Filtration of oxygen through strata of water or absence of oxygen (anaerobiosis) solution of CO ₂	Filtration of air through layers of soil Effect of gaseous CO ₂ (?)
Mechanical factor	Simple solutions or colloidal suspensions	Agglomerate of solid particles of various diameters enclosed by liquid films Phenomena of capillarity, surface adhesion
Biological factor (qualitative and quantitative)	Presence of a single species of micro-organism absence of other species or presence of a few others when this forms part of the experiment Presence of multicellular animals and plants	Presence of an unknown number of microbiological species sometimes with an extraordinary number of individuals Presence of other multicellular animal and plant organisms
Chemical reaction of environment	Course of one chemical process	Course of several contemporaneous chemical processes and often of all the processes known in soil ammonification nitrification denitrification different types of nitrogen fixation decomposition of pectin and cellulose decomposition of various carbohydrates, etc.

in a pure culture and under conditions appearing to us the optimum, to fix an amount of nitrogen almost within the limits of error in analysis, the bacteriologists of to-day require that the experiment should be carried out in a current of nitrogen and also demand a current of air when it is a question of nitrifying a little ammonia *in vitro*, we are obliged to realise that nothing is more different from the natural conditions than the experimental conditions, whereas we know scarcely anything of certain fundamental processes upon which the economy of nature is based

One proof of the falsity of deductions which may be drawn from experiments *in vitro* is afforded by the ease with which micro-organisms

which may possess certain chemical characteristics (*e. g.* that of fixing nitrogen), may also lose them. Hence the reason for the rejection of any classification of bacteria based on the existence of chemical characters and of the rejection of classifications of the genera devised by BEIJERINCK, such as *Photobacterium* and *Azotobacter*. It is doubtful whether the many species that possess the power of fixing nitrogen *in vitro* are endowed with nitrifying properties under natural conditions. In other words, agricultural bacteriologists have almost completely put aside the teaching of pathological bacteriology, viz. ;— that an innocuous micro-organism can suddenly become, not only pathogenic, but excessively virulent; also, the more the pathologist extends his studies, the larger becomes the circle of bacteria which in the first place may be inactive (though there is no such thing as an inactive bacterium in nature) but may become pathogenic on occasion. Finally, we have forgotten that the pathologist teaches us that, whereas it is comparatively easy to lessen the virulence of a micro-organism and even render it entirely harmless, very often the most difficult task that presents itself in the laboratory is to restore to a micro-organism its original virulence, or in general, any chemical character that it may have lost, even if we ourselves were instrumental to the loss, or conscious that it was lost at a given moment. In other words, whereas the pathological bacteriologist regards every bacterium as a pathogenetic agent that may have lost its virulence, from the standpoint of the agricultural bacteriologist, the micro-organisms in which he is interested are perfect, constant and never-changing forms.

This is however entirely at variance with the lessons of morphology for it is impossible to demonstrate that a bacterium *is not* sporogenous and that an *immobile* bacterium may not also become mobile. It is well-known that demonstrations based on negations are often untrustworthy.

Even in natural environments, the conditions necessary to produce certain chemical processes (such as nitrogen fixation) are difficult to induce, and require very special conditions, not always available; this seems sufficiently evident from the fact that nature, contrary to her usual habit, does not seem to have created a single system for the attainment of similar ends, but several, *e. g.* soil, anaerobic and aerobic soil nitrogen fixers, symbiosis with algae, mucedineae, and higher plants. It is clear that the conditions favourable to one system cannot be suitable to others, and we are unable at present

to explain how these systems can exist together simultaneously in the same soil, as seems to be the case for example, in a field of clover or lucerne. Yet with the aid of a little ordinary agar, *Bacterium radicicola* can be isolated from the root tubercles, *Clostridium Pasteurianum* isolated with Winogradsky's solution, *Azotobacter* with a solution of mannite, and all this at the same time and without the slightest difficulty.

That the soil itself, owing to its chemico-physical structure, should have enormous influence in determining any given chemico-bacteriological process, or, at least, in making one paramount over another, is shown by the knowledge we possess (or rather do not possess) regarding the mysterious physiology of schizomycetic protoplasm which causes mobile (or immobile) bacteria to undergo (actively or passively, we are uncertain which) attractions and repulsions due to the action of physical and chemical factors. Upon this influence depend the well known phenomena of thermotaxis, phototaxis, chemotaxis (or rather trophotaxis) and osmotaxis, that often combine or follow one another in nutrient soils not composed of a single substance, viz. the greater number of artificial soils, however simple they may appear to be as compared with most natural soils. In fact, BEIJERINCK'S well known experiments have shown that mobile bacteria in immobile media, and even in solid soil, that is permeable and easily broken up, do not unite or reproduce themselves at random, but according to recognised laws and currents of movement, caused by the concentration of the medium by chemotaxis and by the chemico-physical nature of the medium (emulsion, precipitation, solution). In short, they form true chemotaxic figures determined by the species and by the soil. In this manner, LEHMANN and CURCHOS explained and defined more accurately, bacterial levels (niveaus) and turbidity, that is to say, the very different positions assumed by bacteria at various levels of special liquids, which sometimes form layers like leaves of paper, or more or less diffused agglomerations. If this occurs under conditions of development, which are physically very simple and chemically uniform, what might not take place under *natural soil* conditions or in cultivated soil, where everything is totally different and varies from centimetre to centimetre, and perhaps in every cubic-millimetre?

KOLKURTZ and MARSSON have already distinguished three zones in the self-purifying waters of rivers; the Polisaprobia, the Mesosaprobia (sub-divided into two sections according to number of indivi-

duals) and the Oligosaprobia. They state that similar zones exist in soils which owe their origin, as can well be understood, to the greater or less need and utilisation of atmospheric oxygen.

All the above facts show clearly the distinct necessity for finding a way to avoid such difficulties both in the field of observation and that of experiment.

It is not easy to give a new trend to experimental methods, as it is at present impossible to obtain natural and sterile soil upon which pure cultures of one or a few species of bacteria can be allowed to function.

Bacteriologists have however shown signs of changing their methods.

I personally, since 1903 have succeeded in obtaining in sterilised soil and on sterilised but intact leaves, by means of pure cultures, the pectic fermentation of the soil, and have demonstrated that active micro-organisms, which induce pectic ferments *in vitro*, lose that property as soon as they are made to function in sterilised arable soil, which contains the same nutritive substances as the liquid medium. C. BARTHEL, although starting from a different standpoint, has reached much the same conclusion. Since 1918, he has been growing imperfect fungi on sterilised agricultural soil, and the following year he extended his experiments to the schizomycetes. This marks great progress, but BARTHEL does not fail to point out that mere sterilisation produces a distinct effect on the soil itself, as the heat renders soluble many substances that are insoluble at ordinary temperatures. It also, I may add, coagulates many colloids and perhaps destroys a considerable number of active ferments, without taking into account that the conditions are too artificial as regards the thermic, optic and respiratory factors.

It may be possible in the future to consider the possibility of making microbes accustomed to large doses of such antiseptics react in natural agricultural soils which have been treated like must with antiseptic anaesthetics such as chloroform, or with instantaneous fixing agents such as sulphur dioxide. At present, however, it is vain to anticipate theoretical conditions entailing a radical change in our technique, which time alone can bring about.

It is easier, and perhaps wiser, to continue on the lines of observation and investigation. For this purpose it will be enough to attach less importance to the direct study of agricultural soil that has long been cultivated by man, but to concentrate on virgin soils in which

only natural processes have had an opportunity to act, and that have not been affected by mechanical tillage, the application of manure, or chemical fertilisers, and the importation of other than the native flora, whether polyphysical, or monophysical, and preferably, on soils that are actually in the process of formation.

Virgin soils are not very uncommon as no region exists, especially if mountainous, that does not possess a certain amount of land that may be regarded as virgin, or may at least have been reduced to that condition by having been left untilled for many decades. In Italy such soil is very common, especially in the plains where pastures, that have not been broken up for many years, are not infrequent. In such soil, the micro-organisms will have had time to form layers, or in any case it will be possible to trace the soil mixtures that can be attributed only to natural agents, whether chemico-physical, water and air, or biological, such as soil insects, coleoptera, or earth worms. National parks may also be very useful for these experiments, especially the American national parks, where the soil is really in its natural condition, and to a less degree the artificial national parks in Italy where the soil is not at present in such a condition but will return to it.

Forest land in general will be most valuable for this work, for as GOLLA says, it represents (as compared with ground only occasionally covered with vegetation), a condition in which there is a slowing down of the evolutionary processes taking place in the physical structure and chemical composition of the soil, and this change dates from the time that plant life has acquired possession of the soil. Equally useful are the high moors and meadow moors forming in many forests, or on land that has been reclaimed from marshes and cultivated for the first time.

Such soils have been very important in connection with the root-bacteria of Leguminosae. Very interesting from this point of view is BARTHEL'S work on soil bacteriology and the faecal matter of the Polar animals in North Greenland. Generally, in this case, the soil was typically virgin, since it had never been trodden by the foot of man, and nitrogen bacteria, for instance, were never found there.

The soils of the second class, those in course of formation, are rarer. They are further not always useful for our purpose, for the commonest types are alluvial which in consequence have carried with them all the bacterial flora and have settled with all the biological

characters of the original soil from which they were derived. Others, however, exist and probably every geologist could mention special types belonging to his own district. Thus, all Italians know the famous, much fractured formations known as the "argille scagliose", red, blue or whitish in colour and rich in fossils, which are found especially at the base of the foot-hills of the Appenines of the Po Valley, whose origin is a matter of dispute as to whether it is igneous or sedimentary, and which often form a series of undulations like a rough sea.

These clays, probably exposed by landslips, still in many places offer no foothold, for "tree or flower" in LEOPARDI's phrase, and hence we see the strange spectacle of one slope exposing its gaunt multi-coloured skeleton while the other is clothed by the hand of man, smiles with a luxuriant growth of cereals and leguminosae, in association with vines, elms, mulberry trees and fruit-trees, thus affording a striking contrast to the vast tracts where only at intervals a tuft of grass appears in places when a little vegetable mould has found its way by accident, while the greater part of the surface is *not even covered with lichens*.

In such cases, it must have been the exposure of the spot, and the greater adaptability for agricultural operations that decided the intervention of man in one part rather than in another. This intervention manifested itself by providing the soil with all its requirements, especially by making use of large supplies of manure, organic matter containing bacterial flora, thus bringing about a real invasion of the sterile or almost sterile soil by means of schizomycetes, hyphomycetes and protozoa.

Another essentially Italian type of soil, the so-called "terre forti" occurs in the neighbourhood of L'itna and extends for many kilometres. The most interesting part lies in the western section, formed by the famous Siali, a chain of totally naked clayey-limestone hills that also present an interesting problem on account of the difficulties of re-afforestation. Here all plants, even thallphytes and musciueae, are entirely absent and no one has noted the presence of microscopic flora. As, however, it is well-known that the mineral components of the soil are analogous to those of the rocks still *in situ*, there is another field of work that is of considerable interest as regards the invasion of micro-organisms, viz., the bare surface of the rocks at all altitudes, on which no lichens have hitherto grown, apart from the rock faces that have a lichenous covering and the deposits



14. It is a high mountain in the north of the
S. of the city of London (Emilia Romagna)



FIG. 1 and 2. The same rocks entirely covered and entirely bare, respectively. The "sich" of Misterbrance (western section of the "Terra Firma" in the Type of Terra Firma).

of micro-organisms, which are sure to be found in the cracks and crevices of the rocks, especially wherever the formation of some vegetable mould has permitted the growth of sporadic herbs and shrubs.

It is evident that the ideal soils for study would be those that could be discovered at the time they were really sterile, which would allow observations to be made of the slow and natural invasions of microscopic life, which certainly preceded the macroscopic forms. Do such soils exist? They do exist, although they are rare. These are the volcanic soils that have been erupted from the interior of the earth where the incandescent magma rises to temperatures incompatible with the presence of any forms of life, even the most primitive.

And since this subterranean magma that has been erupted varies greatly from district to district and in almost all the volcanic zones ends by becoming part of the surrounding agricultural soil (only rarely are the lavas and other eruptive products antiseptic as well as sterile), there is a possibility of studying the natural micro-biological successions in soils of very varied chemical composition while in process of formation.

These conditions are however somewhat unusual in certain parts of the world as has already been said. There are not many extinct volcanoes in Europe, and the few that are active, Vesuvius, Stromboli, Etna are all to be found in Italy, the country which in this respect is especially privileged.

The importance of making a study of the successive establishment of biological species in newly-formed soils is not a new idea, except as regards the microbiological forms that are now under consideration; the eminent Italian agricultural botanist Orazio COMES (formerly the representative of Italy at the International Institute) has already discussed the question of the macroscopic species, taking advantage of the opportunities offered him by our "dread destroyer Vesuvius". COMES maintains that the first plants to inhabit the rocks are unicellular algae, which may be easily collected by scraping the surface of the cracks and hollows. These algae associate with fungous masses and give rise to lichens. In fact, according to the scientist-poet, the interesting lichen *Stereocaulum Vesuvianum*, follows the algae and soon develops in bushy form and spreads over the scoriaceous surface. It is quickly followed by dozens of other lichens; and later by mosses and liver-worts which are the precursors of the vascular cryptogams, succulent plants, and gramineae, and of woody plants *e. g.*

the famous and typical *Ginestra odorata*. Although it is true that my assistant and myself, in reviewing the ideas of COMES have been able to confirm his statement that *Stereocaulum* is indeed the fore-runner of the macroscopic flora, and further to add that it alone is found on recent lavas (c. g. the flow of 1906), where it is soon joined by other lichens, we have found also that from then onwards the appearance of the other types (mosses, vascular cryptogams and phanerogams) has by no means followed a course parallel to the palaeontological phylogensis of these groups, and that the biological factor is probably of little importance in effecting the disintegration of the lavas, that prepares them later to become part of the agricultural soil. This however in no way detracts from the novelty or the importance of the conception of COMES nor does it affect its application to the preceding microscopical investigations of unicellular algae reported by COMES and confirmed in our own work. Our first observations have already yielded results which are perhaps of importance, such as the discovery that there are no anaerobic nitrogen-fixing micro-organisms in certain soils. Since the production of naturally sterile lava within the cone of Vesuvius is continuous, it would not be difficult to remove larger or smaller portions of this lava and subject them to continuous and extended microscopic investigation, and perhaps in this manner it might be possible to observe a repetition of the phenomena which took place in the azoic ages of the earth, and finally led to the development of life.

When we consider that upon lava, once incandescent, and upon soils directly derived from it, there has arisen the most intense cultivation known in the world, and also that from these areas bearing witness to the horrors of the struggle with the devastating plutonic forces, we pass almost without interruption to the enchanted ground of Capri and Ischia, Portici and Naples, we cannot help feeling that this district offers to the biologist greater opportunities than any other for studying the earliest stages of life, while to the agriculturist it presents an unequalled chance to obtain knowledge respecting the formation of plant soil.

Finally I believe that a new impulse will be given to the studies of agricultural bacteriology from the moment that scientists will agree to adopt the two following measures.

1) The *standardisation* of methods of research in connection with fertile soils,

2) The *study of the local schizomycete flora*. In order that this



Fig. 1. It is entirely or almost entirely black. A small, irregularly shaped area in the center.

study may be profitable it should be associated with the standardisation.

It is greatly to be hoped that an agreement on these two points may be reached on the basis of my proposal to the Managing Committee of the International Conference of Soil Physics to be held shortly. One of the advantages thereby gained would certainly be the discovery that just as higher plants exist which are met with everywhere from the Pole to the Equator, from the seashore to the perpetual snow-line, and at every altitude and climatic zone, and each has its particular species, so there are schizomycetes peculiar to every soil, latitude and altitude.

By means of the suggestions made and above all by unity of aim and method we may hope that bacteriology will make the progress that might be anticipated in the interests of agriculture, the industry which more than any other, always and everywhere, is the source of the well-being and happiness of mankind.

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CITRUS INDUSTRY IN JAPAN

1. GENERAL OUTLOOK. — As one of the oldest agricultural countries in the world, agriculture is permanently established in Japan and the soil fertility is restored and perpetuated by the most concentrated process of tilling and fertilising. Farming is everywhere intensive and conservative, as the natural result of over-population and topographical differences. Climate is generally favorable to all kinds of temperate-region crops, and the vegetation is extremely rich in proportion to the moderately excessive rainfall. The inhabitants are admirably suited to farming as they are born with a love of nature and they are very expert in the detection of slight crop differences. There is no other country which includes so many kinds of crops useful to mankind as are found in Japan, which has records of agricultural industry even from the mythological period. Under such conditions, Citrus fruits were introduced as an agricultural crop as early as the first century A. D. and were gradually distributed over all the Southern part of the Island Empire. During the Tokugawa period the cultivation of mandarin oranges in the province of Kii (Wakayama Prefecture) reached such a degree, that the general situation as regards cultivation, shipping and marketing, was really upon the modern basis of productive output, and was remarkably progressive and independent. A great advance in selecting varieties, combatting natural enemies, and in adaptation to market requirements has resulted in raising the standard of the citrus industry to the front rank in Japan.

2. PRODUCTION. - In 1920, Japan proper, exclusive of Taiwan (Formosa), produced 2 962 513 quintals of Citrus fruits, valued at 24 302 204 Yen, being 34.41 per cent of the total fruit crop produced in that year. The Mikan or loose-skin oranges (*Citrus nobilis* Lour., *C. deliciosa* Ten., etc.) predominate as regards production and distribution, followed by Natsu-daïdai, a summer orange resembling the American grape-fruit, and Washington Navel orange. The table gives their comparative production in the year of 1920.

Unit	Production	Value
Mikan	2 085 928 qx.	17 726 367 Yen
Natsu daidai	514 952	3 145 589
Washington Navel Orange	129 651	1 762 875
Miscellaneous Citrus Fruits	231 982	1 667 373
Total	2 962 513 qx	24 302 204

The Citrus fruits are produced in the warm south-western part of the archipelago, and the prefecture of Wakayama (Kii Province) was noted historically for orange production and is still leading the industry. In recent years the Shizuoka, Kanagawa and Osaka prefectures made rapid progress and the prefectures of Ehime, Yamaguchi and Hiroshima are their important rivals. The existence of 26 770 329 orange trees in Japan is recorded for 1920 and the ratio as regards increase of trees, Shizuoka Prefecture predominates, where two million trees have been planted in the past fourteen years. Annual exportation of varying amounts have been made to Siberia, Canada and the United States, and the situation as a whole appears promising. Only one type called Unshū Mikan (Satsuma orange in America) is exported for table use and other kinds including kumquats, shad-docks, sweet oranges, lemons, mandarins, tangerines, and Daidai (the sour orange), are all for home consumption. No economic production of grapefruit, bergamot, citron and limes is to be found in the Japanese territory. No by-products have been developed in Japan except a small citric acid industry on Shikoku Island.

3. CULTURAL REQUIREMENTS. — In the Citrus districts of Japan, the temperature is not as high as in other great Citrus producing centres of the world (in Wakayama Prefecture, annual normal temperature is 15.3° C) and it is necessary to plant trees on the sunny-side of the hills. Terraces are constructed to the top of the hills and very expensive stone walls are occasionally built to prevent the soil erosion. Rainfall is well distributed throughout the year varying from 1104 to 2566 mm. per annum according to the location, and the Inland-Sea districts are best protected from the excessive rainfall. The terrace formation favors also the drainage of the surplus soil moisture. The soil varies from sandy loam to clay, but usually contains gravel which produces a soil of better physical quality. Soils of archæan rock origin are found in the best producing areas and those of volcanic

rock origin, inferior to the former, are also common. The Washington Navel orange is more suited for planting on the open flat area of the hill-top where the surface soil is deep and rich. Satsuma oranges are grown on the hill-side without giving attention to the nature of the soil. Natsu-daïdai thrives well on the rich soil of the flat low ground where the cold wind does not reach the plant. Among these three, Satsuma orange is hardiest and is best fitted to the prevailing conditions of the Japanese Citrus belt. The Washington Navel orange requires more intensive care and is not successful unless care is taken as regards manuring drainage, and pruning. It is not difficult to obtain successful results with the natsu-daïdai but the quality of the fruit itself is insufficient to secure a good market price. The area devoted to cultivation of Natsu-daïdai has not been extended in recent years, but the Satsuma orange alone is gradually covering a wide region. There is practically no severe frost damage in Japan and fully developed trees are to be found in several localities.

4. CULTURAL METHODS. - The cultural methods for oranges in Japan are very simple. No implements are employed for tilling and manuring. The plants are usually grafted on the trifoliolate orange (*Poncirus trifoliata* Raf.), and they are planted out about 3.5 m. apart. Nitrogenous fertilisers, chiefly from soybean press cakes or fish manures are universally applied in addition to superphosphate of lime and wood ash. Inorganic nitrogenous fertilisers are very little used but green manuring and mulching is common. Farm yard manures and night soils are also popular but no bone dust or blood manure is used. In ordinary farms about 4.5 lb. of fertilisers are applied to a tree about 20 years old, which will contain 0.401 lb. of nitrogen, 0.272 lb. of phosphoric acid and 0.034 lb. of potash. Hoeing and light ploughing take place at frequent intervals, and the soil is very well cleaned during the intervening season. The border of the terrace is utilised for tea-plants or *Pyrethrum* (for insect powder), and sometimes the entire ground beneath the trees is planted with sweet-potato or Konnyaku tuber (*Conophalus Konjak*). The plant is trained naturally, usually with very low standard, or 3-4 stemmed. Washington Navel orange, however, has recently been found to give more satisfactory results when tipped in order to prevent too much lank growth. A moderate amount of pruning is occasionally practised, but no thinning of flowers or fruits. Spraying for the control of diseases and pests is general, and fumigation of all the plants of one given locality is made, partly at the expense of the local govern-

ment in order to combat certain pests. Hand-picked fruits are usually carried back on the shoulder to the cellars or packing houses. A considerable number of storehouses are constructed exclusively for oranges, for the purpose of marketing later when the price of fruit is very high.

5. MARKETING. — Most of the Citrus districts of Japan have their own organisation to facilitate the marketing, but they lack central organisation like the exchange system which exists in America. The central Assembly of the local growers associations is an advisory organisation which meets once a year in one of the leading Citrus producing localities. The local association is either a co-operative body established under the Imperial law, or merely a mutual benefit association. The selling associations usually collect the products from the properties of the members, ship them to the chief markets through the contract agents and sell the goods by auction through wholesalers who receive a certain percentage commission from the associations. The latter do not handle producers' goods separately, but classify them according to their own grades and ship them under their own brand. The choice of the market and of the wholesalers and shippers is made by the board of managers, who also supervise inspectors sent to the chief markets. As regards business, members are entirely dependent on the ability of the managers, who are themselves experienced growers, and there is no mutual competition in selling. They are better producers, ship more fruits of high grade than others, and naturally they can obtain better returns.

Besides selling associations and growers' mutual associations, the producers also have credit associations, buying associations (for the purchase of their commodities) and pest-control associations. Many have their own paid experts, who play an important rôle in instructing farmers as to improved methods of cultivation, pruning, storing, packing and selling.

Certain localities so far have insufficient organisation for their mutual benefit, and their profit is greatly reduced by profiteering, local wholesalers, shippers and middlemen. The support of the Government, however, gives opportunity to the growers to inaugurate the new associations to protect their interests.

6. STORAGE. — Storage of fruits is one of the most important features of the Japanese Citrus industry. Satsuma orange and Washington Navel orange are stored until the beginning of May and Natsu-daidai until August. The construction of the storehouses

varies in different localities. The simplest form is nothing but an outdoor pile of fruits covered with green leaves, ferns and straw (Nagasaki Prefecture). A better type takes the form of an underground cellar protected by an impermeable wall and tiled or thatched roof. These primitive forms are not suitable to store fruits for a long period, as fruit decay (caused by *Penicillium* spp., *Botrytis* sp., *Macrosporium* sp., etc.) sets in rather quickly. Typical orange storehouses are usually two-storey buildings of various sizes, with a double wall for temperature regulation and with bottom and top ventilators. The floor is high enough to keep out the soil moisture, and the ceiling is built at a height sufficient to protect from the solar heat. Along the central or side aisle which traverses the building the stacks are installed with shelves carrying moveable trays which contain fruits in one or two rows. The entire building is surrounded by shade trees and is usually provided with a veranda or adjoining chamber to facilitate the transport or packing of fruits. Frequent examinations of the fruit are made during the storage so as to detect and remove the decayed fruits. About 34 qx of fruit can be placed in a storehouse of 15 sqm. Such storehouses generally belong to the proprietor of the orchard. Packing houses, usually without sizing machines and boxmaking equipment, are either private or belong to the association. No cold storage or curing room is found at present. According to the writer's experience in curing the Satsuma orange it appears to be more satisfactory to market the fruit early in September, and possibly this practice will come about in a few years.

7. HAULING, PACKING AND TRANSPORTING — Since the Citrus trees are planted in the mountainous district, the hauling of the fruit to the packing houses is not an easy task. It is mostly carried on the shoulders of the pickers, but in some localities a simple form of aerial cable system is installed to transfer the fruits from the orchard to the bottom of the hill. The field boxes, which are usually the size of kerosene boxes, or straw or bamboo baskets of various sizes, are emptied at the packing house, where the sorting is done by hand and judged by sight. The classes or grades are different in various localities, but there are usually five grades. The fruits are packed in a box, of the size of a kerosene box, except in the province of Kii, where much smaller boxes are used. The boxes are then nailed and fastened by straw rope, to facilitate handling.

The transportation is mostly done by railways, and the Imperial Railway Department usually grants a special rate for lot shipments

of the Citrus fruits. Some Growers' Associations charter steamships for the exclusive purpose of transporting the fruits, and certain villages even have their own small motor boats. Motor trucks are also used for frequent service.

The biggest market for Citrus fruit is Tokyô, where considerable amounts are consumed especially at the end of the year. More than seventy per cent of the production of Wakayama goes to Tokyô, where bulky shipments from the Kanagawa and Shizuoka prefectures are sent early in the season. Moji (on Kyûshû Island) is another big market for oranges, to which practically all the products of Kyûshû Island are sent. Kôbe and Osaka also absorb a large amount of Citrus fruits, mostly from the Inland Sea districts. It is interesting to note that the prefecture of Osaka is the centre of production of the store fruits, and they are mostly shipped to Tokyô during the spring months.

8. ACCOUNTING. - It is impossible to state the cost of production of Citrus fruits in Japan. The average land owner usually takes as much land as he can cultivate personally, which will be about a hectare, or at most not more than two hectares.

The tilling and fertilizing are usually carried out by his own labor, with the possible aid of his sons or grandsons living in the same house. The picking and hauling may require occasional hired labor, which will cost the producer between 0.75 and 1.50 yen per man per day. In an average good year, about 120 qx of Satsuma fruits can be produced per hectare, which can be sold at 9.50 yen per quintal including the expenses of packing, hauling and transport. Thus the gross income for fruits per hectare will amount to 1 140 yen, all selling expenses paid. In certain places this sum increases to 10 000 yen or more. This increase is due to skill in management or selling, to the good situation of the orchard, or to the wise choice of the variety and the extensive use of fertilisers. In ordinary cases, the total cultural expenditure and taxes are not very high, and the net income will be at least 1 000 yen per hectare in cases when the grower pays no interest on the land capital. The price of cultivated lands is extremely high and the Citrus orchard newly set out is either in an inconvenient location or on unfertile soil, requiring large expenses for maintenance. However the additional expense will be cheaper than paying interest on purchased cultivated lands. Many growers who inherited their lands from predecessors have considerably extended their orchards by opening up new lands, thus forming the basis of the present expansion of the Citrus industry. Large scale

plantation of Citrus fruits is however mostly unsuccessful, since accommodation for large orchards is practically unobtainable under existing conditions in Japan.

9. DISEASES AND PESTS. -- Many injurious diseases and pests found in the Japanese Citrus orchards are common to other Citrus producing countries, and a detailed explanation will not be necessary. Scale insects of various genera and species are prevalent everywhere, but most of the growers are now employing the spray of oil emulsion or soda-resin mixture, which is giving very successful results. In certain districts (Nagasaki Prefecture), cyanic acid gas fumigation is absolutely necessary at least once in three years to destroy certain kinds of scale insects. Citrus scab, melanose (*Phomopsis Citri*) but greasy spots (certain bacteria) are rather common, and round spot diseases (*Mycosphaerella Horii* and *Macrophoma Citri*) are also rather prevalent. Gummosis, scaly bark and footrot are rarely found, and recently pink-disease was reported in Kyûshû Island. Bordeaux mixture is universally applied as a means of control. Stem-borer, leaf-miner, many kinds of aphids, red-spider and silver-mite are also commonly found, and for many of these lime-sulphur is employed for spraying.

Among introduced pests Citrus Canker (*Pseudomonas Citri*) and flute scale (*Icerya Purchasi*) may be mentioned. Citrus Canker was first found in the nursery of the Fukuoka Prefecture about 1899 and since then it has spread rapidly into many important Citrus districts. It is worse on the nursery plants, trifoliate orange hedges and the navel oranges, and its absolute control is impossible, since the leaf-miner is widely distributed. Bordeaux mixture, however, is found to be very effective in the control of the disease if proper precautions be taken to check other insect pests by an occasional lime-sulphur spray. The flute scale was first introduced from Formosa into Shizuoka Prefecture in 1910. The Government efforts to eradicate the pest were not successful and the insect now occurs in many important Citrus producing districts. The damage, has however, been greatly reduced by the distribution by the Government of artificially reared Vedalia insects (*Novius Cardinalis*).

The Mediterranean fruit fly, which occurs in Formosa as a natural enemy is not however found on the main islands. Several kinds of fruit flies of minor importance occur in the northern part of Kyûshû Island, but eradication work has been almost completed in recent years.

10. SATSUMA ORANGE. — The most characteristic feature of the Japanese Citrus industry can be seen in the great effort of the growers to improve the cultivated varieties. The mandarin orange (*Citrus deliciosa*) has long been the most important kind of orange in Japan, and it is interesting to hear that a magnificent old tree aged about 600 years old is still in existence. In Western Japan, especially in the provinces of Hizen, Higo, Chikuzen and Chikugo, another kind of large fruiting loose-skin orange was under cultivation some long time since, probably about 350 years ago. Its commercial value had not been known until about 1880, when rural enterprise gave rise to the new industry based upon the more modern varieties. This particular orange, which was named "Unshû" about 100 years ago became popular with Citrus growers for plantation purposes, and a great effort was made to replace mandarins by the new orange. The new industry has made rapid progress in the past 40 years amounting recently to a yield of about 13 000 000 yen per annum.

The Unshû orange (*Citrus Unshiu* Hort.), which is known elsewhere under the name Satsuma orange, is an orange resembling the "King of Siam" and Kunenbo (*Citrus nobilis* Lour.), with large wingless foliage and large oblate seedless fruit. The appearance of the tree is as vigorous as a shaddock, and the branches are not so delicate as those of the sweet orange or mandarin. The size of an average fruit is decidedly larger than the common mandarin of the Mediterranean region and the pulp is much sweeter and better flavoured. The plant is very hardy and resistant to various diseases, especially to Citrus canker. It is far more prolific than the mandarin, and its cultural requirement is less strict. Since its first appearance in commercial culture, all Japanese growers have abandoned the planting of the mandarin, because in every respect Satsuma proved to be superior. The most striking characteristic of this orange, is that it starts fruiting at a very early stage, the fruit ripens early in the autumn when no other Citrus fruits are to be found on the market, and the fruit is easily stored for a long time. Its seedless character is due to the lack of viable pollen as in the case of Washington Navel orange, and unless other good seeding varieties be planted near, the fruit remains permanently seedless. The quality of the pulp is admirable, as it is extremely juicy and refreshing and leaves no pith in the mouth. The scent does not resemble that of mandarin or tangerine, the flavour of which is not popular. The Satsuma orange thrives best on the trifoliate orange.

PLATE IV



Fig. 2. — Satsuma mandarin on fruiting branch.



Fig. 3. — Satsuma mandarin on a fruiting branch.

11. VARIETY SEGREGATION OF SATSUMA ORANGE. — In the course of cultivation, several varieties of Satsuma orange have developed. The earliest maturing variety, called "Wase" (*praecox*) was originally brought to the fore by a farmer only about 20 years ago, and an annual production of 200 000 yen is estimated chiefly from the Hiroshima Prefecture, where it has been raised with success as a commercial variety. The fruit ripens about the 20th of September under normal conditions, and can be shipped in the beginning of October.

A large flat fruiting kind widely distributed in the nurseries of Owari Province under the name "Kairyô Unshû" has been known in Nagasaki Prefecture as "Nakashima" for a long time. Its commercial value was first discovered by a nurseryman of Idzumi Province and its propagation on a large scale is responsible for the present prosperity of the Satsuma orange industry. The fruit matures after the "Wase" variety and its high quality should make it worth planting on a large scale as a commercial product. This variety is a good cropper with high grade fruit.

There are two ordinary varieties commonly distributed in old groves, the flat kind or "Zairai-shu" and the round, very prolific kind "Ikeda Unshû". They are not highly recommended for commercial culture except for storing purposes, since the rind seems more resistant to rough treatment.

The propagation of these kinds is very easy by budding or grafting on trifoliate orange, the seeds of which are most readily obtainable from the semi-wild shrub. The Satsuma orange gives bad results on lemon or sour orange stocks but does very well on Yuzu (*Citrus junos*).

It is worth mentioning that in North America, especially in the State of Alabama and other Gulf States, the Satsuma orange industry has been established on a large scale. It is expected to produce fruit worth one million dollars in 1922, though the average tree is only eight years old and the area devoted to its cultivation is not more than 4 800 hectares. The industry is making wonderful progress as the entire business is organised in the most scientific and systematic way. In many respects the Satsuma orange should be regarded as an international crop and the study of this particular orange will be of value to the Citrus producing countries.

12. OTHER JAPANESE VARIETIES. — Attention is called to other profitable Japanese varieties. Natsu-daïdai is unquestionably infe-

rior to the American grape-fruit in its fruit quality, but it is much hardier. The fruit is oblate, large sized, deep yellow, with refreshing juicy pulp and matures late in the winter. The fruit can be stored until very late and the peel is excellent for marmalade. Its commercial value was first found in the prefecture of Yamaguchi, and the cultivation was then extended to many other localities. The plant is very resistant to Citrus canker and is vigorous even when neglected.

The Kinkan or Kumquat is widely cultivated throughout the Citrus districts, but there are several places in Wakayama Prefecture exclusively devoted to its cultivation. The commercial species of Kumquat is Naga Kinkan (oval Kumquat, *Fortunella margarita* Sw.) and the round kind (Maru Kinkan, *Fortunella japonica* Sw.) rarely occurs in ordinary cultivation. Meiwa or Neiha Kinkan (*Fortunella crassifolia* Sw.) is gradually increasing on account of its good quality of peel and its larger size. The fruits of Kumquat are mostly used for preserve, or are eaten raw especially by children.

Hirado and Egami shaddocks may next be mentioned. These varieties of shaddock do not require a tropical climate but can thrive in a temperate region. Both kinds are characterised by the round shape, extremely smooth rind and non-pinkish pulp. The quality of pulp almost matches the best Siamese pomelo in early spring. They came from Nagasaki Prefecture and are still local varieties, but their superior quality is undoubtedly worth very wide recognition.

Yazu is not really a Japanese variety, but is a native of Asia. It is a wild orange most closely allied to *Citrus ichangensis* of Yangtze region (China), but was introduced into Japan from time immemorial. Its economical value almost equals that of the lemon and its pleasantly acid juice is far more suitable for seasoning fish than lemon. The flavour of oil from the rind of Yuzu is characteristic and most agreeable, so that the rind is generally used to flavour dishes. The plant is the next hardiest to the trifoliate orange and its seedling serves as an admirable stock for various kinds of Citrus fruits.

13. FORMOSAN CITRUS VARIETIES. — Citrus culture in the island of Taiwan (Formosa) is still in the early stages but in recent years it has been gradually systematised to develop into a promising industry. The best Citrus fruit known from Formosa is Ponkan (*Citrus poonensis*), for which a market has now been well established in the main islands.

Ponkan is a kind of loose-skin orange closely resembling the tan-

gerine of North America. The fruit of Ponkan is far larger than the tangerine or Satsuma orange; rather rounder in shape and usually with a mamilla-like protrusion at the base. It is the sweetest kind of orange ever known in Japan and the size, shape and the brilliant colour of the fruit are almost matchless. It is grown in a tropical climate; the tree is quite upright and a considerable number of plants can be set out in a small area. The quality of the rind of the fruit is most durable, and it may be shipped for a considerable distance. The fruit has never been tested in Florida or in the Mediterranean region, but it is not difficult to foretell that some day this orange will become popular in these areas.

Tankan is another important loose-skin orange of Formosa and to some extent it rivals the Ponkan. The pulp quality of Ponkan is however far superior to that of Tankan, which therefore does not hold such a good position. Sekkan, the Formosan sweet orange, is an oblong, light colored kind, which contains very few seeds. In a wet tropical climate it thrives much better than any other kind of sweet orange, and its extra-fragrant and saccharine pulp makes it rank with the world famous Shin-hau sweet orange of the Canton region in China.

Numerous kinds of shaddocks are grown in the island of Formosa, and they find a sale in the main islands. Many good varieties such as Tōyu An-yu, Peiyu, Matôt, etc. are well known to consumers.

14. THE FUTURE PROSPECT OF THE JAPANESE CITRUS CULTURE. —

Besides Citrus fruits, Japan produces various kinds of deciduous fruits such as persimmons (*Diospyros Kaki*), sand pears (*Pyrus serrottina*), peaches and nectarines, grapes, apples and also loquats (*Eriobotrya japonica*). The area devoted to the cultivation of these fruit trees does not usually trespass on the Citrus area, and it is true that the hill population of south western Japan is greatly favoured by planting Citrus fruits, the only crop suited for this region. Citrus culture in Japan does not interfere in any way with the production of important crops, which are indispensable for the maintenance of the large population, which has an important bearing on the future of the Japanese Citrus industry.

The use of fruit for dessert is not really a Japanese custom, but the habit is growing year after year with the adoption of western ways of living and is resulting in the annual expansion of the fruit market in the large cities. The demand for Citrus fruits is therefore growing most steadily, and the market price shows continued advances in

recent years. The cultivation of the orange eating habit amongst the people of the north-eastern part of the archipelago will also help the market. This custom undoubtedly favors the future prospect of the industry.

The exportation of Japanese Citrus fruits has been disturbed by the closing of the market in the Siberian region. The Japanese products however reach the Central Canadian cities easily, and will find a market there without fear of much American competition. Marketing in the interior of northern China and Manchuria will also be developed. In any case, the exportation business is quite promising, and it will form a decisive factor in the future development of the Japanese Citrus industry, if the farmers organise the business personally and wisely.

As to the further improvement of the industry, many advantages will be found in paying greater attention to the choice of the variety, methods of handling and selling, and the establishment of the by-product industry. The Japanese markets almost entirely lack the good summer varieties of Citrus, and the possibility of the successful raising of lemons in the Idzu archipelago and in the Inland Sea district, American grapefruit in Nagasaki region and Valencia sweet oranges in the Miyazaki district will be the subject of thorough trial tests; the Bergamot orange will also be introduced for trial.

In conclusion, it should be emphasised that a large proportion of the world's population as yet receive no fruits of the Hesperidean Apple for their food, and the extension of Citrus production is really a necessary requirement. For this purpose, the Citrus producers of all countries must cooperate in exchanging knowledge leading to the increased production and better protection of their valuable crop, and it is the duty of the Japanese Citrus growers to give facilities to their foreign colleagues with this common aim in view.

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THE RESTORATION OF CHESTNUT WOODS

Since the opening up of the lines of communication in the Central Plateau and the Cevennes, the extended cultivation of cereals hitherto considerably neglected, has to a certain extent reduced the importance that was previously attributed to chestnuts as an article of diet

In addition to this, except in certain districts in the Var and Ardèche, where the growing of choice types is maintained, the lack of adequate selection has resulted in failure in export trade. Frequently the value of the crop is insufficient to meet the costs of collecting and the chestnuts are left as food for the animals.

Finally, the tanning industry has been so far developed that the existence of the chestnut groves is menaced, as the owners do not hesitate to sell their unproductive trees to obtain immediate benefit. This fact combined with the damage done by the ink disease on large stretches of wooded territory in certain Departments, gives a serious aspect to the question.

The view of the magnificent stretches in the Central Plateau and the Cevennes is therefore threatened, and bearing in mind the shortage of manual labour, and the type of soil, which does not allow the substitution of the former trees by remunerative crops, the amount of unproductive waste land is constantly on the increase.

How can this be remedied effectively?

In certain Departments, where new crops have replaced the former chestnut groves, the soil has proved of higher value. For example in la Cher, la Vienne, la Haute-Vienne and la Dordogne, the crop yields have been doubled and even quadrupled. In such cases the problem of restoration need not be considered. But in at least ten other departments (Ardèche, Corrèze, Gers, Lot, Lozère, Corsica etc.), the disappearance of the chestnut groves may not only extend the

unproductive areas, but also, on rough, sunken ground may cause the streams to have a tendency to flood, as for example in Corsica and Gard.

Restoration should therefore be effected. The tanneries, although faced with the fact that they may be deprived of one of their first class tanning materials, have recognised the importance of this decision and have agreed to levy a small duty per ton of extract ; the sums thus collected and deposited with the Syndicate authorities constitute a first step towards the restoration of the chestnut groves, taking the form of advances made for purposes of planting and selection.

The problem of restoration is however influenced by the reasons for clearing, whether sale of the wood for the factories or by the ink disease attack.

In the first case, it is advisable to use indigenous varieties for replanting, and to have carefully selected varieties in the exposed valleys. The newly-restored groves should give adequate returns after 11 to 12 years, and as tannin extracts are not considered to be profitable from trees under 50 years of age, a long series of unproductive years may run before the factory need be contemplated. The net profits from the sale cover the cost of breaking up the land and replanting and leave the proprietor with an appreciable credit. In this way the interests of both the growers and the tanneries are reconciled.

In the Departments where the ink disease is prevalent, the problem of restoration is much more complicated. Even if it is agreed that the disease is of a parasitic origin, the actual nature of the parasites is still uncertain. It is however acknowledged that the parasite exists in the soil and that the organisms remain for an indefinite period in infested areas. Hence the reason why entirely unsatisfactory results have been obtained on newly-planted areas. Sterilisation of the soil is therefore essential before planting native varieties, or recourse must be had to exotic varieties resistant to this disease.

Sterilisation has given comparatively satisfactory results on small areas and on friable soils, but this does not hold good with large stretches and on rocky land favourable to chestnut trees.

Attention should therefore be directed to the introduction of exotic varieties. This idea was first put into practice by M. PRUNET, Professeur à la faculté des Sciences, Toulouse, who fifteen years ago,

made experiments with Japanese varieties. The success obtained was followed by numerous requests for further Japanese stock, but difficulties in obtaining authentic plants of the best varieties has led to disappointment.

The plants obtained, although resistant to ink disease, have been somewhat stunted in growth. Other haphazard trials have been made, without any knowledge as to the methods of cultivation of the chestnut in Japan and China, and in consequence the work of restoration has made very little progress since the time when PRUNET began his tests.

A new difficulty has recently arisen which further complicates the possibilities of replanting with exotics. For several years, the chestnut groves in the United States have been ravaged by a blight disease as persistent as the ink disease and caused by the Ascomycete, *Endothia parasitica*, which attacks the trunk and branches and causes rapid decay.

C. L. SHEAR, the American mycologist has observed *Endothia parasitica* in China and Japan, but the damage reported in these countries is negligible. But when introduced into America, the parasite acquired an exceptional virulence, and has caused the devastation of a large number of chestnut trees. A similar disaster is likely to occur if Japanese stock is imported into France. As a means of prevention, the Minister of Agriculture, on the recommendation of the Epiphyte Committee, has prohibited all transport of Japanese fruits and plants.

Under these conditions, attention should first be given to the existing varieties in China and Japan. Abstracts have been made from the report of MIÉVILLE after his investigations on fruit trees and chestnut trees in Indo-China, China and Japan.

In China, practically the only variety to be found is *Castanea mollissima* (= *C. Ducloux*) Blume which forms large stands in Yunnan, Ileang and Pozzi, and also in other parts, especially in the vicinity of Pekin. This well-developed tree is from 20 to 25 metres in height and grows on the mountains at an altitude of 200 to 1600 or 1800 metres. The fruits which are sold in the Yunnan and Pekin markets resemble closely the French Chestnut. MIÉVILLE has not noticed *Endothia* in any of the areas he visited, but it appears that this species is very resistant to *Endothia* and, in the United States, nurseries have already been prepared especially for this species, preparatory to filling up gaps caused by disease.

Castanea mollissima has been introduced into Korea ; the fruits are very popular and are preferred to the native chestnuts.

Several varieties are to be found in China, so far not identified, but in the case in point the trunk is probably that of *C. mollissima*.

The first on the list in Japan is *C. crenata* Siebold and Zuccarini, known locally as "Shiba Juri", which grows wild in large quantities. Well-developed trees (height 15 to 25 m.) are found in all the southern high mountainous areas, and in the north on the plains and the low mountain ranges ; fine groves are also to be found, either chestnuts only or pines and oaks intermixed.

Other varieties, probably of long-standing are as follows :

1) *C. Hibuta* : "Gury Noki Hibuta", height 12 to 15 m. found in Southern Tokyo ; fruits lack sweetness.

2) *C. Gasha* "Guri Thai Sho", height 6 to 10 m. ; noted for the 7 to 10 bracts.

3) Japanese chestnut "Guri noki odai" : cultivated native variety, grafted on "shiba guri".

4) Japanese chestnut "Guri noki osaya" much cultivated ; good cropper and early, but susceptible to *Endothia*, which destroys it after two or three years. The natives, ignorant of the existence of this disease, attribute the decay of the trees to cold etc., although the temperature in reality is never below 2° C. The observations made by M. MIÉVILLE seem to indicate that *Endothia* is even in Japan, not as serious as hitherto believed.

5) The Tamba chestnut grafted on "Shiba Guri" is selected as the most important variety, deserving special attention for its popular form of fruit. Three types are distinguished :—

a) "Tamba Guri Okuté" found chiefly in the province of Tamba, height 10 to 15 m. ; late ripening.

b) "Tamba guri" : medium var.

d) "Tamba bon Guri" : very early ; — 3 achenes per flower, but frequently the two lateral achenes do not ripen but the middle achene develops into a good sized chestnut.

Endothia appears also to attack these varieties but concentrates on the graft rather than on the stock "shiba gur" which is resistant to attack.

The information supplied by MIÉVILLE facilitates the choice of species and varieties advisable for the restoration of chestnut groves, hitherto devastated as a result of the ink disease.

In China, the *Castanea mollissima* Blume, and in Japan,

C. crenata Siebold and Zuccarini "shiba guri" with the various cultivated types and Tamba grafts, particularly "tamba guri", are worthy of special note.

The nurseries should therefore be planted with these particular species and varieties. But it should be remembered that the parasite which has caused so much damage in the United States is frequently found also on the grafted varieties in Japan. The fruits or plants should for this reason be disinfected before transport into France and close inspection should be made in the nurseries to ensure immediate elimination of all infected plants. This inspection will only be possible if the number of nurseries is strictly limited.

Apart from the tests made by PRUNET which only refer to small areas, ELISSAGUES, a rich proprietor in the Basses-Pyrénées, has set apart certain plantations in the vicinity of St. Jean de Luz entirely for "shibba guri" and "tamba guri". More than 5000 trees are in full bearing and the "tamba guri" trees are sufficiently advanced to provide excellent fruits. In addition to this, ELISSAGUES has distributed some 1000 plants to neighbouring landowners. ELISSAGUES is to be congratulated for taking this initiative which shows that complete success may be obtained with Japanese, stock planted on a large scale.

Encouraged by this example it is proposed to establish a limited number of nurseries. One of these nurseries, filled with stock supplied by MIÉVILLE is to be situated at Aubenas under the direction of COUDERC, either on his property or on the plain of Aubenas, far from the native chestnut varieties.

A second nursery will be founded in the Jardin de Jussien, in the Versailles park and in the land attached to the Arboretum of the Museum National d'Histoire Naturelle. This will be under the direction of MANGIN, Inspecteur des Parcs.

It is proposed to lay out a third at Ossès or at Sauveterre (Basses-Pyrénées), under the direction of the tanneries.

A fourth has been suggested in the neighbourhood of Drive under the direction of the "Service phytopathologique" situated in this district. This will give opportunities to study the problem of the diseases of the chestnut.

The choice of nurseries once fixed, the necessary authorisation from the Ministry of Agriculture will be obtained allowing the importation of the required fruits, on the condition of thorough disinfection. A regular inspection service will be organised to eliminate

diseased plants. After several years, the plants obtained and provided will be distributed with the consent of the Pathological service at a low cost to the communes, associations and proprietors who make application.

Thus, the problem of restoration in France depends on the one hand on the clearings made of old trees for sale to tanneries, the planting and selection of native varieties, and secondly on the ravages of the ink disease, and the planting of Japanese or Chinese stock raised in a limited number of large nurseries and notified as liable to *Endothia parasitica*.

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NEW FORMS IN THE FIRST GENERATION OF ANIMALS

The production of new animal and vegetable forms by the crossing of polyhybrids is well known at the present time. It is recognised that by crossing types, homozygous or pure but differing in at least two mendelian factors, and by crossing later with individuals of the F_1 , a second generation F_2 is produced including in addition to parent types, a certain number of new forms. These are to be attributed to new combinations of the hereditary factors, different from those recognised amongst the parent types. The number of new characters found in F_2 is in relation to the number of different factors existing in the two parent types.

The following formula represents this appearance of new forms in F_2

$$2^n - 2.$$

Let n represent the number of differential mendelian factors in the two parent types. Thus, for example, for 3 differential factors, $2^3 - 2 = 6$ new forms may be estimated; for 4 differential factors, $2^4 - 2 = 14$. These new forms are not however always apparent, as it often happens that different combinations of factors produce the same external characteristic. Consequently a result is obtained which does not seem to correspond exactly to the formula $2^n - 2$. But on verification as regards genotypes and hereditary formulas, the formula $2^n - 2$ is found to be reliable.

This occurrence of new forms in F_2 as a result of crossing polyhybrids may therefore be admitted as a general law.

With reference to F_1 , it has been found in many cases that animals of the first generation inherit the characters of one only of the parents which is in consequence termed the *dominant type*. This dominance is only evident when dealing with qualitative factors, i. e. factors producing the same effect, both in heterozygotes and homozy-

gotes and that these factors are all united in one of the parent types. Hence, for instance, the cross between a black homozygote agouti rabbit (wild), and a blue homozygote rabbit gives in F_1 , a black agouti because the two qualitative differential factors, of blue and black agouti, are united in the black agouti.

This however is not always the case. It frequently happens that the progeny F_1 is of a new type, different from the parent types, which is repeated in the F_2 progeny and will be referred to later. When a cross is made between two different pure lines, a half breed is obtained which may be considered in a general way as a mixture of dominant parental characters and new characters. It is not infrequently the case that the latter are more numerous than the former.

These new forms of the F_1 generation may be divided into two groups, namely the intermediate forms and the forms entirely new or "coenogenetic".

I. INTERMEDIATE FORMS. — Very little information is available concerning animals. Several instances are however referred to by various writers in connection with half-breeds, but the study of their genetics has yet to be made. Probably these intermediate forms may be attributed to the fact that the parental characters are determined by *quantitative factors*, the intermediary stage being due to the fact that these factors are heterozygous. The inheritance of the bars in the hen Coucou de Malines and the Plymouth Rock confirms this hypothesis. In short, a bar factor gives a dark 'Coucou' colour, with wide black stripes and narrow white stripes, more or less intermediate as regards tone between black and light "coucou". The latter is produced by two bar factors, resulting in bigger white stripes. This example indicates also that for quantitative factors, new intermediate forms of F_1 progeny may arise from a cross between two homozygous parents, *differing only in one quantitative factor*. It will be seen later that for qualitative factors, at least two differential characters are essential if the new variety is to be shown in F_1 .

The production of blue Andalusian fowls by crossing white with black appears to be of the same nature. This is an intermediate form between white and black, due probably to the heterozygous nature of a quantitative factor (BATESON). The heterozygote will in consequence give the blue type. These experiments, still in progress, have so far shown that the blue tint is also due to complementary factors, acting in all probability on the blue factor. The latter is a factor belong-

ing to an inhibition group. In homozygotes colour formation is entirely prevented, except for a few small patches, where the effect seems negative. With heterozygotes the inhibition is reduced to half. There are therefore complementary factors which lighten or intensify the blue tint.

In this group of intermediates may also be included the phenomena of incomplete dominance. Several examples are familiar: the feathers on the feet, the additional claws, the combs, the size of certain organs, etc. etc. But the real nature of these phenomena is still unknown.

II. NEW FORMS, "COENOGENETIC". — These are also found in F_1 after union of two different genotypes, and may be termed the new synthetic forms. This occurs frequently and the completely new characters are entirely distinct from the parent characters, *e. g.* the black rabbit, result of a cross between a blue 'beveren' and a brown 'havanais'; or the new characters are the result of a new grouping of the parental characteristics, *e. g.* the short-haired wild rabbit is the result of a cross between a black short-haired and a wild Angora.

The new synthetic forms can be classified as follows

a) *Complementary forms: synthesis of two different genotypes, but possessing identical qualitative factors.*

The mendelian factors which are associated with the two genotype parents combine to produce the new synthetic genotype, generally identified by a new character or phenotype. These new forms are therefore complementary synthetic forms. They correspond to the BATESON "compound characters".

Typical examples of this group have been obtained at the Institut de Zootechnie de Louvain, especially in the case of the cross between albino and coloured rabbits. This cross frequently produced in F_1 , a generation quite distinct from the parent types. For example, a cross made between a male albino and a female black resulted in 10 young rabbits, all of which were the colour of the wild rabbit. In the same way, a cross between a male albino and a female blue has given 4 wild coloured rabbits. The appearance of this new wild form, quite distinct from either the albino, the black or the blue characters, is easily understood when the synthesis of the parent genotypes is considered. It may be taken that the albino has eliminated the fundamental factor of colouration A , but possesses in latent form, the other factors of colouration, *viz.* factor B (brown), factor C (black), factor D , (intensification of colour), and factor G (agouti),

giving in the presence of the factors B , C , and D , the wild colour. On the other hand the black female parent possesses the fundamental factor A , and in addition the factors B , C and D . The blue female also possesses factor A , and also factors B and C . The production of the wild type is therefore indicated as follows.

- 1) ♂ Albino $aBCDG$
 + ♀ black $ABCD$

 F_1 wild $A B_2 C_2 D_2 G$

- 2) ♂ albinos $aBCDG$
 + ♂ blue ABC

 F_1 wild $A B_2 C_2 DG$

Further crosses with coloured rabbits have given similar results (1). The walnut comb obtained by crossing the rose comb and the pea comb (BATESON) and the production in F_1 of coloured hens (BATESON and PUNNETT) after crossing two white parent types follows the same system. These also are complementary synthetic forms, each parent possessing one of the factors of the new form.

By crossing two animals each having inherited factors of a known series, a new character results which corresponds to the phenotype produced by the sum of the two formulae of the hereditary parental characters. It may be assumed that these complementary synthetic forms *are invariably heterozygotes for at least two factors*.

These data throw also a new light on the phenomena of atavism. Alongside the recessive characters reappearing in F_2 , in the case of animals, a further series of characters may be distinguished which may be classed among the wild form characteristics from which they are derived. These reversions are most probably complementary synthetic forms, as the above-mentioned instances suggest. Atavism reappears each time that the two genotypes, of which the sum of the inherited factors produced the old phenotype, chance to be reunited.

b) *A synthetic type in mosaic form as a result of the juxtaposition of two or more dominant characters, of which each parent possesses at least one.*

(1) FRATEUR J. L. Mendelsche synthetisvormen bij dieren - *Genetica*, IV, 3 and 4, 1922.

In this case a new phenotype is produced, which is however the result of the reunion in a single individual of two characters of which each parental type possessed one. The new form F_1 , is therefore like a mosaic of parent characters. Several such cases are quoted in Mendelian literature, as for instance, the following examples.

By crossing black hens with pea combs with a white Leghorn cock with single comb, have been obtained in the F_1 generation, white birds with a few black specks and pea combs.

This can be easily understood, since the white Leghorn is dominant over the black, and the pea comb is dominant over the single comb. The crossing of an angora rabbit having a wild coloured fur with a greyish short-haired type, gives in the F_1 , wild short-haired types, as the wild is dominant over the grey, and the short-hair is dominant over the angora.

c) A special form of synthesis by juxtaposition occurs *when a dominant character is united with an intermediate*.

By crossing white Andalusian hens with single combs with a black cock with pea comb. *c. g.* a black turkey head Malines cock, in the F_1 blue birds with pea combs have been obtained. In this case the cross, white with black, gave an intermediate blue, and the pea comb dominant over the single comb.

* * *

These different synthetic forms are frequently noticed in the F_1 generation after crossing two animals of different breeds, and this is apt to disconcert the breeders. With the above data to hand, it should be possible to foresee results rather more clearly for more than one cross. As also many of these new characters are mendelian, there is a possibility of making homozygous the basal heterozygous factors and in this way to fix these characters. With this in view, crosses must begin to be made amongst the F_1 generation. As a result, the F_2 generation will be dissociated according to the general formula for polyhybrids. $9 : 3 : 3 : 1 ; 27 : 9 : 9 : 9 : 3 : 3 : 3 : 1 ; 81 : 27 : 27 : 27 : 27 : 9 : 9 : 9 : 9 : 9 : 9 : 3 : 3 : 3 : 3 : 1$, etc. And in each group there will be a homozygote.

This dissociation differs however from the usual process in that *the numerical distribution of the parent types and the new types is reversed*. Below is given for comparison purposes the dissociation of an ordinary dihybrid and of a synthetic dihybrid.

a) *Ordinary dihybrid.*Parents $PD + PR$ F_1 $PD + PD$ F_2 $9 PD + 3 N + 3 N + 1 PR$ b) *Synthetic dihybrid.*Parents $P + P'$ F_1^1 $N + N$ F_2^1 $9 N + 3 P + 3 P' + 1 N'$

In the dissociation of the synthetic dihybrids the two parent types are only discernible in F_2 in $3/16$ of the individuals. One of the new forms (the synthetic form) is present in all animals in F_1 and in $9/16$ in F_2 . The other new form is only found in $1/16$ of the F_2 and it takes the place occupied by the recessive parent form in the ordinary dissociation. This new form is also the result of the absence of all the factors having combined to form a synthetic character. This new form is completely recessive *vis-à-vis* all the other forms in F_2 and is an homozygote. This appears to be the only type capable of serving as a reactive agent for purity as regards the other dissociated characters, as it possesses none of the factors in question.

It is therefore by recrossing the forms dissociated with the form present in the lowest proportions that will enable the breeder to identify the homozygote animals. The latter, in other words, do not dissociate in the F_1 generation when crossed with the new recessive type.

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AGRICULTURAL TECHNIQUE AND FARM ENGINEERING IN GERMANY

The present position occupied by agricultural technique and farm engineering in Germany is the result of scientific and economic development during many decades and represents the fruit of systematic enquiry into the various agricultural problems and of success in the universal competition in the use of machines and implements. In the interests of truth, it must however be admitted that the industry and technique in Germany are greatly indebted to English and American pioneers, and to some extent also to Belgian inventors, although in many cases the originality of form and idea are purely German, or have been adapted and developed according to German scientific methods.

If we consider the state of affairs at the close of the last century, and especially during the first ten years of the xxth century, we shall find that there already existed in Germany many experimental farms fully equipped and organised in accordance with the most up-to-date ideas, as a result of the propaganda work of the Association of Agriculture in Germany founded by Max VON EYTH in 1883, on the model of the British Royal Agricultural Society.

The 1907 official census of German farms showed that out of 5 736 082 farms, 1 497 975 already used machines. It is important, however to notice the ratio of distribution of machines among the farms of different sizes: (See table pag. 54).

It may be seen from these statistics that even in 1907 there were 23 566 farms of over 100 hectares, and 262 191 of 20 hectares and more that were almost entirely machine-worked and 1 065 539 farms of 5 to 20 hectares were $\frac{3}{4}$ machine-worked. On the other hand of the 4.4 million small-holders owning less than 5 hectares of land, only a very small number employed a limited quantity of machines in their

Size of farm		No. of farms	Farms provided with machines
Under 2	hectare-	3 378 509	3.95 %
2-5	"	1 006 277	32.2 "
5-20	"	1 066 539	72.0 "
20-100	"	262 191	93.0 "
100-500	"	20 068	97.5 "
500-1000	"	3 129	99.0 "
above 1000	"	369	99.9 "

fields. As the farms of 5 hectares represented 77 % of the total of 5.74 million German agricultural farms, estimated in 1907, it is evident that the application of intensive methods to German agriculture must depend upon the care and attention to these small holdings.

The necessity for this provision was further proved at the outbreak of the War in 1914 and by the consequent blockade resulting in a dearth of supplies, which also continued during the years following the cessation of hostilities

All these facts have naturally stimulated the movement for the increase of home production.

Firstly, it is important to ascertain the classes of machines most in demand, which would give an idea as to what other machines could also be used in order to assist the machine power on the farms to cope with the innovations. The census quoted gives figures up to 1907 but these do not include simple field implements such as forage cutters and others which are necessary even on the smallest farm.

On farms of 5 to 20 hectares the most popular machines are as follows — 1) Threshers ; 2) Cream separators ; 3) Reapers ; 4) Seeders ; 5) Roller-mills.

On this class of farm, there is no question of steam ploughs and cultivators.

On farms of 20-500 hectares the order is as follows :—

1) Seeders ; 2) Mowers ; 3) Threshers (half driven by steam) ; 4) Cream separators ; 5) Roller-mills ; 6) Cultivators ; 7) Potato diggers ; 8) Steam ploughs.

On farms of 500 hectares and more, the requirements are similar although a larger number of threshers and reapers are used, and the steam ploughs take the fifth instead of the eighth place.

Unfortunately it is not possible to ascertain from statistics

whether the different classes of machines have been used to the same extent by German farmers since 1907 as no census is available.

The only official information to hand is to the effect that, owing to the decrease in territory following on the Treaty of Versailles, the agricultural area in Germany has been reduced by 16 % compared to the pre-war conditions.

At the present time the German Republic possesses 670 000 fewer farms than before the war and has lost altogether 4.5 million hectares of cultivable land.

The number of machines and implements therefore that can be disposed of, is necessarily diminished but the reduction is counter-balanced by the fact that the supplies are not excessive and further there is a great demand for agricultural machinery and implements on the part of the small farmers whose number exceeds 4.8 millions. The dearth of provisions during the War and in the years of scarcity following the armistice have even more forcibly brought home the lesson that the German people must obtain their food supplies from their own land.

This concerns both State and people in that thousands of millions are annually expended on the importation of cereals from abroad. The State believed that by means of the requisition and direct administration of the crop yields it would be possible to make the national production suffice to meet the demands of the people.

It soon became clear that these methods would not cope with the requirements, since the reduction made in the price of corn for the purpose of diminishing the cost of bread decreased the purchasing power of the farmer, so that he was not able to buy chemical fertilisers or machines, until in the summer of 1921 the regulations were relaxed to the extent of substituting for requisition the payment of the tax, under which arrangement only part of the crop was confiscated by the Government.

Thus production decreased instead of increased, so that instead of the necessary intensive farming, there was a danger that extensive agriculture would become the rule. This was the actual state of affairs in December 1921 when the Agricultural Association presented the scheme, "Support of German agriculture" with the intention of increasing production and attention was given to the theoretical and practical standpoints of both technique and industry.

If agricultural production in Germany is to be increased to the extent that importation from other countries will be rendered un-

necessary, the land formerly under cultivation must be cultivated more intensely and the swamps and waste land reclaimed.

In the German Empire before the War there were some 31.8 million hectares of land utilisable, of which 4 million hectares were left uncultivated. Even now when the country has been geographically reduced in size, it may be calculated to contain 3.5 million hectares to be broken up. This would require the use of many machines and of a large amount of fertilisers, thus entailing much expense.

It is however, easier to intensify production in the case of land that has been previously cultivated as indicated by the following facts.

Before the War, about 16 million hectares were under cereals and legumes in Germany; at present the area is limited to some 14 million hectares. Yet, if it is assumed that even to-day, hand-sowing or broad casting with a seeder is practised on 25 % of the farms, a saving of 120 kg. per hectare or 420 000 tons of seed could be effected by the use of machine drills. On the remaining 75 %, 75 kg. per hectare or 787 500 tons per annum could be saved by the same means, so that by the more general and wider use of the drill, some 1.2 million additional tons of grain and legumes could be saved for feeding purposes.

Another important addition to the above rational method of sowing would be the mechanical sifting out of inferior seed, and considerable progress has been made in this direction. If this sifting were properly carried out on the arable land in Germany it would be possible to reckon on an increase of 1 to 2 millions of tons.

Thousands of tons could be saved annually by the extended use of manures and fertiliser distributors, and the use of reapers and binders would reduce the loss of grain in threshing, which amounts to about 100 kg. per hectare, and further increase of production could be obtained by the more general use of the cultivator, and by practising the same hoeing operations in the fields as those customary in the gardens.

Prof. KING (Madison), Head of the Soil Cultivation Section of the Department of Agriculture, Washington, and Dr. RUSSELL (Rothamsted Experiment Station) who conducted an inquiry on behalf of the British Ministry of Agriculture, have both come to the same conclusion that farmers should profit by the thousand years experience in Asia and seek to intensify production by means of cultivation.

The advancement of German agriculture depends on a complexity

of technical and economic questions and it will depend upon the energy displayed and on the possibility of finding a solution to these problems whether German technique and industry will depend more upon internal than upon external conditions.

To the machines included in the census of 1907 may be added several others that have come into use during the last 15 years, especially.— internal combustion engines and electric engines, both fixed and movable, steam motors, motor ploughs and tractors, fertiliser distributors, apparatus for loading and unloading, seed sifters and beet diggers.

The necessity to improve agricultural technique tends to a continual increase in the demand for machines, apparatus and implements. In fact the post-war Exhibition held at Magdeburg in 1917, at Leipzig in 1921 and at Nuremberg in 1922, presented a striking example of the enormous number of new machines available for agriculture and also of the capacity of the German manufacturers to supply them. The position of the latter has been strengthened by recent political and economic events. The extensive pre-war importation of machines has almost ceased owing to the closing of the frontiers, first from outside and later in the interests of national economy, from inside.

Figure I shows the number of machines imported compared with those exported

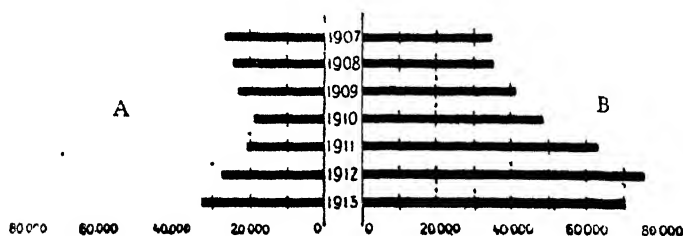


FIG. I

A Pre-war imports
B Pre-war exports (Value in marks)

The machines etc. made in the United States, England, Canada, and Sweden were formidable rivals, and the large number imported between 1907 and 1913 reduced the output of reapers, threshers and cream separators of home manufacture (See Table II).

TABLE II.

	Reapers	Threshers	Cream separators
1907	27 910	2 345	705
1908	25 380	2 108	657
1909	22 390	1 847	687
1910	19 244	1 450	688
1911	19 545	1 499	832
1912	19 917	1 656	710
1913	32 279	1 827	824

This state of affairs naturally underwent a sudden change on the outbreak of War, which continued during the four years following the Armistice. The number of machines now imported has become very insignificant.

The present exchange rates have largely contributed to hinder the importation of agricultural machinery and to encourage the post-war economic policy and the national desire that only German machines should be employed on German Territory.

The only exception has been made in the case of Sweden by the commercial treaty drawn up in 1920, the terms of which permit the import of cream separators manufactured in Sweden, up to a maximum of 2 000 tons; allowing an average weight of 20 kg. per separator, this would mean 100 000 machines, or treble Sweden's pre-war export. A glance at the sales effected by the German firms during the first few years preceding the outbreak of hostilities, shows how great a blow would have been dealt to this branch of German industry were it not for the fact that the condition of the exchange prevents any Swedish competition on German territory.

In the meantime it must not be forgotten that since the War the agricultural engineering industry in Germany has been occupied solely with the requirements of home agriculture and has succeeded to such an extent that it has little to fear from any foreign competition.

This great improvement due to the change in general conditions has brought about a corresponding increase in the output of German reapers, the importation of which in 1913 reached 322 800 quintals.

The export figures of this rising industry show that, while it has completely absorbed the national market, it has at the same time acquired an important position in the foreign markets. In 1910 reapers weighing not more than 523 quintals were introduced into

Germany and of these 85.9 quintals were sent to the free state of Danzig.

As the official statistics for 1920 only give total figures, and no particulars as regards the various classes of machines, we are unfortunately not in a position to compare exports with imports for identical periods.

The data at hand concerning the export of agricultural machines are as follows. During the first six months of 1920: about 4000 mowers at a value of 14 million marks; 1500 reapers and binders at a value of 8 million marks. During the last six months of 1920: 9000 mowers at a value of 24 million marks, and 600 reapers and binders at a value of 3.5 million marks. Total export for 1920 about 15 100 machines at a value of 49.5 million marks (reckoned at a value of 50-60 m. for 1 dollar). If we compare these figures with the 2907 tons of reapers at the value of 2 201 000 gold marks (exported in 1911), we notice a considerable increase. A further comparison between the 24 308 quintals of reapers exported in 1913 and the 87 761 quintals exported in 1921-22 clearly shows the increase in production and export of these machines.

Figure II gives a comparison between the exports in 1913 and in 1921-22 respectively, and although it only gives the total value, it shows the difference between the pre-war exports and the present day figures.

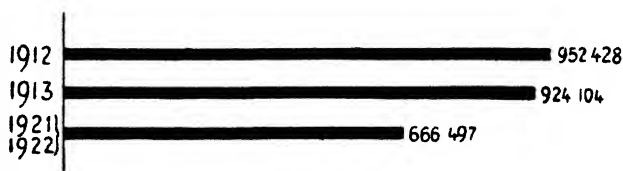


FIG. II.—A. Pre-war and post-war export of agricultural machines.
(Value in quintals).

Figure III gives the variations between the pre-war and post-war sales in certain countries. It must not be forgotten that since the war no agricultural machines have been sent to one great country viz. Russia.

Figure IV shows what good customers Russia and other countries were to one of the largest machine factories. It should however be remembered that the value of the machines exported to Russia in 1913 represented about 32 million gold marks, *i. e.* not less than 40 %.

The lack of export data does not allow any information to

be supplied as to the quantity of machines imported by Russia since the War, and we only know that the number is considerable as regards Soviet Russia and Poland (formerly Russian).

Figures V, VI, VII, give the export figures so far as known for the years 1920, 1921, 1922.

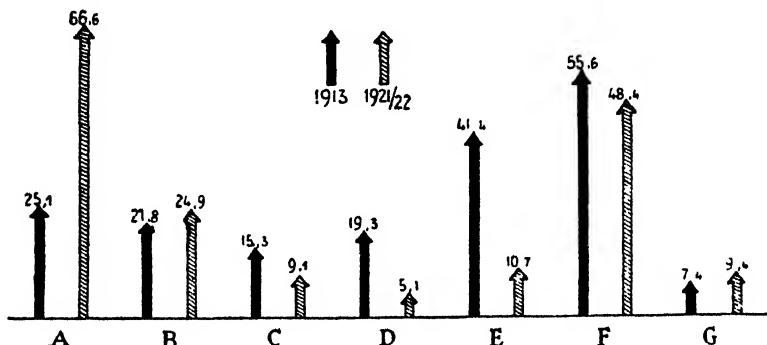


FIG. III. — Countries importing agricultural machines before and after the war.

A = Netherlands

B = Denmark

C = Switzerland

D = Belgium.

F = France

F = Italy

G = Spain

Figure VIII shows the distribution of imports and exports for various countries before the war. Importation especially from England and America has now completely ceased and home needs, which show a marked increase, are met entirely by home production.

Under the reparation scheme, from January 16, 1919 there have been furnished, in a very short space of time at the request of the Reparations Committee, in place of engines and railways tracks that had not been consigned up to the stipulated numbers, the following agricultural machines :

400	Steam ploughs
6 500	Seeders
6 500	Manure distributors
6 500	Brabant ploughs
12 500	Harrows
6 500	Cultivators
2 500	Steel rollers
2 500	Croskill rollers
2 500	Mowers
2 500	Hay turners
3 000	Reapers and binders.

To these should be added various other machines, steam ploughs and threshers with engines, since the consignment of agricultural

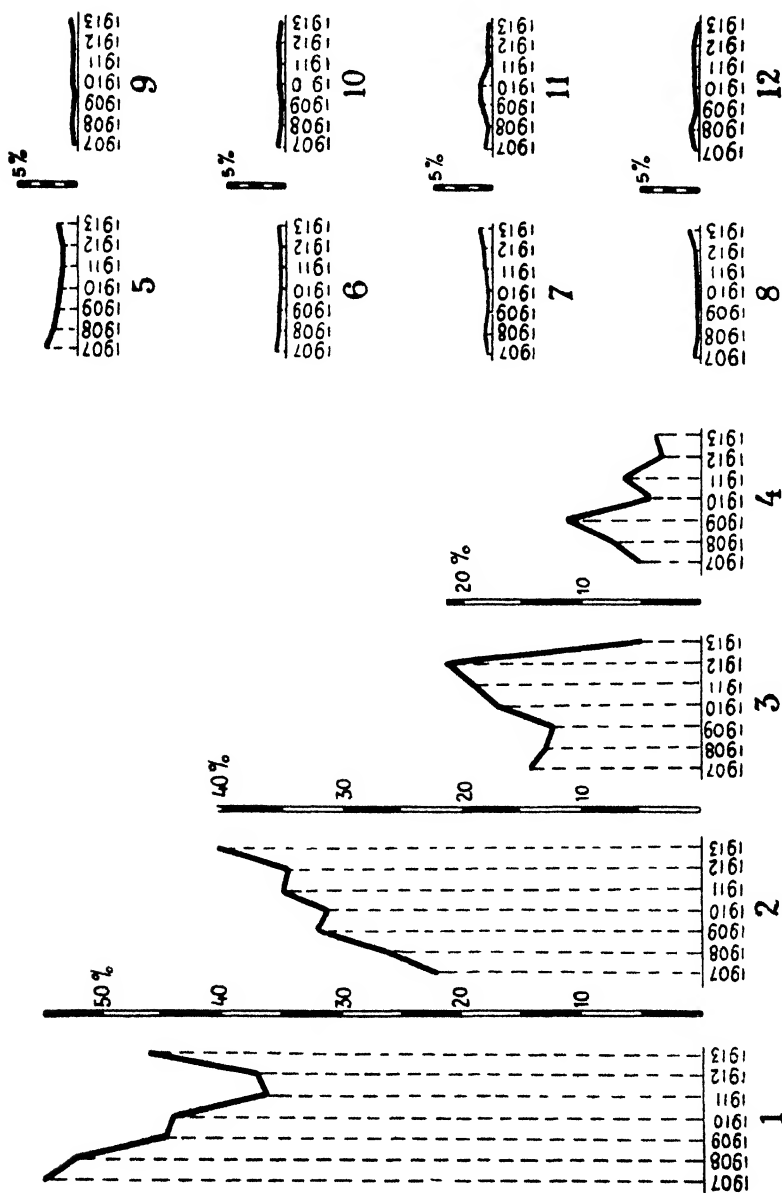


FIG IV

Percentage of sales of one of the principal Machine factories in the various countries before the war.

1. Germany, 2. Russia, 3. Roumania, Servia, Greece, 4. South America, 5. Holland, 6. Italy, 7. France, 8. Belgium,
9. Spain and Portugal, 10. Turkey, 11. South Africa, 12. Sweden and Norway.

material continued for a long time in the form of restitution and of penalties. As far as can be estimated, 2194 agricultural machines

were consigned in 1920 under the head of reparations, 38 038 in 1921 ; and about 16 000 machines and apparatus in the first half of 1922. The supply of machines in this way has not met with the approval

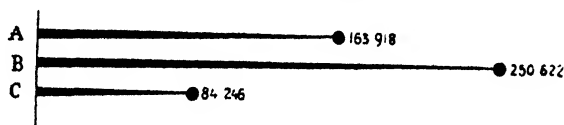


FIG. V.

Export of Agricultural Machines, 1920 (Value in quintals).

A = Agricultural Equipment.

B = Agricultural Machines.

C = Means of transport.

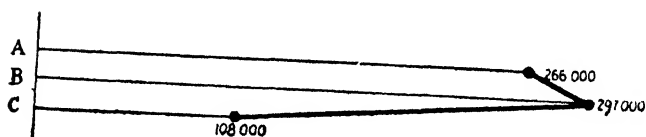


FIG. VI.

Exportation of Agricultural Machines, 1921. (Value in quintals).

A = Agricultural Equipment.

B = Agricultural Machines.

C = Means of transport.

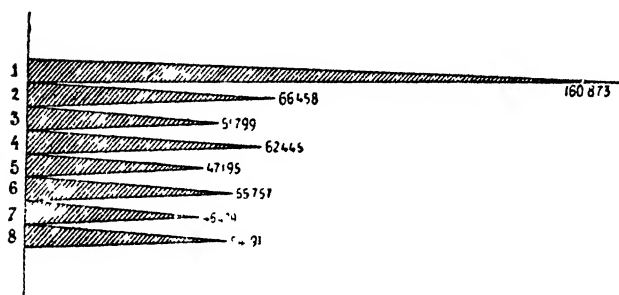


FIG. VII

Export of Agricultural Machines, 1922. (Value in quintals).

1) January-March, 2) April; 3) May;

4) June; 5) July; 6) August; 7) September; 8) October.

of the German Agricultural industry, for in the first place the Government is the purchaser and secondly, such compulsory transactions are not remunerative as compared with exportation.

It is now a question of deciding whether the position of the farm engineering industry and its future prospects in Germany can be regarded as favourable. In the first place, attention should be drawn to the fact that production now exceeds the demand. The number of factories has greatly increased since the war, owing to the transformation of many warfactories into machine factories *e. g.* Krupp, Deutsche Werke, Rheinmetall, Rumpler. The number of German agricultural machine factories may be estimated at about 1000; this includes small firms where repairs are executed.

The large and medium sized firms are united into five societies for the purpose of regulating the prices and conditions of supplying goods and of payment. These Societies include 700 to 800 affiliated firms with some 65 000 employees. One series of these factories is engaged in a single branch of the trade and is limited to certain classes of machines and implements.

The dealers in machines are also organised in a league which includes about 2000 commercial establishments.

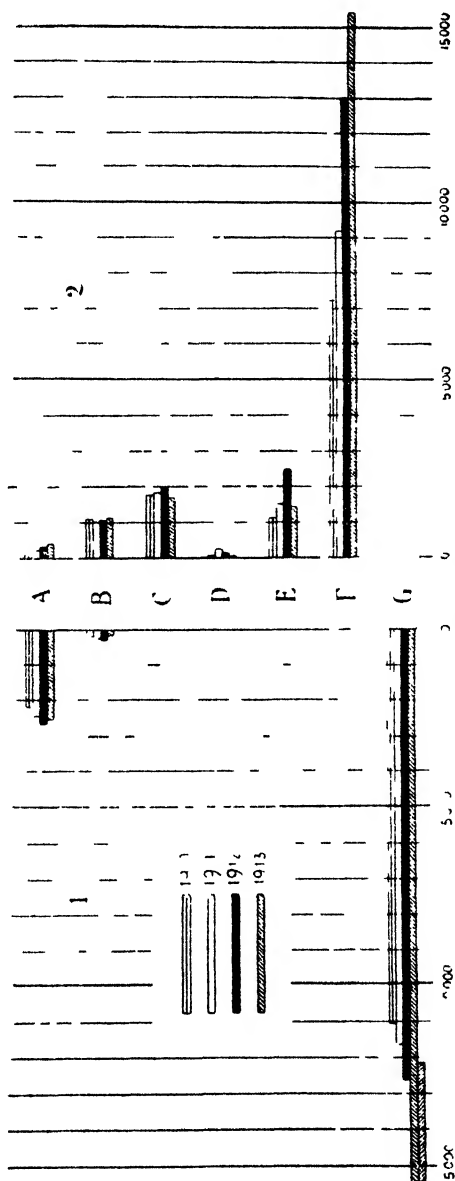


FIG. VIII.
1. Import of Agricultural machines into Germany — 2. Export of Agricultural machines from Germany.
A. England — B. France — C. Italy — D. Turkey — E. Roumania — F. Russia —
G. United States of America

The cost of the machines depends essentially on the price of materials, the chief of which are iron and steel.

As has already been said, only an increased and more extensive use of machines can remedy the loss of land to which the country has been subjected, and for this reason it is necessary that German agricultural engineers should make every effort in order that agricultural technique may develop and extend to all the agricultural districts. Such is the opinion held by all technical, agricultural and industrial circles.

In conclusion, the following suggestion is made, that all agricultural countries should unite to establish a Central International Office where agricultural and technical experts from all the affiliated countries would study the technical problems of to-day and investigate the principles at the base of a systematic application of machinery to agriculture and the scattered results of valuable, isolated experiments could be centralised.

Such an International Agricultural-Technical Bureau would ensure the technique and scientific construction of the agricultural machines and implements on the world's markets. Further it would be a means of co-operation and would be a source of valuable aid. Such a useful Institution would confer great benefits upon the farming industry and above all would assist economy in every country.

It is not only desirable but also most opportune that the International Institute of Agriculture should undertake this important work, for the welfare of agriculture in every State could not be entrusted to any more competent Institution.

S. NUSSBAUM,

*President, Economic Committee of Agricultural Engineering,
Germany*

THE CHIEF DISEASES AND PESTS OF THE ORANGE AND LEMON GROVES OF SPAIN

Although the orange has been grown in Spain from very early times, it seems only comparatively recently to have been attacked by certain diseases. Thus, *Mytilaspis citricola* dates from the middle of the XIX century, other parasites, like *Chrysomphalus dictyospermi* were first observed at the beginning of the XXth century, while some, like *Icerya purchasi* Maskell, only made their appearance a few years ago. The introduction of all these parasites may be attributed to the lack of any proper control of the ornamental plants imported into the country.

There are in Spain over 40 000 hectares under orange-trees, and more than 1000 hectares planted with lemon-trees, yet it may be said that with few exceptions, the agriculturist controls with more or less difficulty and expense all the above-named parasites. He uses all the insecticides, including hydrocyanic acid, of which he has any knowledge, and has enlisted in his service many of the insect enemies of his foes. Hydrocyanic acid is very widely used in the orange-gardens, the method adopted being that recommended by the Department of Agriculture of Washington which has also done much to popularise the adoption of other insecticides which have as their base petroleum, whale-oil, soft soap, soda, resin etc.

The names of all the great agriculturists, Count di MONTORNÉS Y DE LA VALLESA DI MANDER, the Spanish Consul and agriculturist, D. José M^a LAMO DE ESPINOSA, the Valencian agriculturist, D. Emilio LÓPEZ GUARDIOLA, the Spanish Agricultural Engineers, D. José M^a MARTÍ, D. Antonio MAYLIN, D. Leopoldo SALAS AMAT and D. Clemente CERDÁ are associated with the first campaigns for popularising the use of hydrocyanic acid as an insecticide in Spain and the earliest experiments made with this effective gas in that country.

The author made known the most recent works dealing with the subject that had been published in Cape Colony and Australia.

Amongst the Spanish entomologists who have studied the insect parasites of insects injurious to agriculture, special mention should be made of R. P. Longino NAVÁS, Professor of the "Colegio del Salvador" at Saragossa, and D. Ricardo GARCÍA MERCET, Secretary of the "Asociación para el Progreso de las Ciencias" who have given much attention, with conspicuous success, to the insect foes of the parasites of the orange-tree. The author has been able to help in this work also to some extent, thanks to Count MONTORNÉS Y DE LA VALLESA DE MANDER, who assisted him to make a coloured plate in which are represented some of the insects that are useful to agriculture, because they control certain injurious individuals of their own class. Oranges are grown in Spain to the value of over 50 million pesetas, and lemons to the value of more than 1.5 million pesetas, and it is natural that the many cultivators of citrus trees should take a great interest in this source of their wealth. Hence, it is usual to find newspaper articles dealing minutely with citrus plantations and their foes, and this not only in publications professedly interested in agriculture, but also in the daily political press. Although these works may not show special originality in their treatment of the subject of citrus-tree parasites in Spain, they at all events serve a useful purpose in popularising knowledge important to agriculturists.

Most of the books and pamphlets printed give a more or less detailed description of the chief diseases and adverse conditions which affect the orange and lemon. Sometimes however these accounts err on the side of brevity. The descriptions of the malady and the parasite being intended for the large agricultural public, they are rarely sufficiently detailed to enable the scientific entomologist to classify the insect in question.

Hence students must have recourse to special monographs written by trained entomologists if they wish to know the characters of any particular parasite. Sometimes the articles in the daily press contain more useful information than the above mentioned popular works.

The chief plant parasites of the orange and lemon tree in Spain are as follows: the pathogenetic agents of "negrilla" ("morfea", "fumaggine" and "nero degli agrumi") *Meliola Penzigi*, and of root gummosis.

Plant parasites :

Osyris alba L.; *Lichen aurantii*; *Parmeniana Parietaria*; *Agaricus Citri* Inz. ("mal de caña"); *Polyporus obliquus* Fr.; *Meliola Citri* Br. ("mal de ceniza"); *Meliola Penzigi* Sacc. (Syn. *Fumago vagans* Pers.); *Cladosporium Fumago* Link.; *Dematium monophyllum* Ris.; *Capnodium Citri* Mont; *Morphea Citri* Catt. (popularly known as "carbón", "mangla", "negretta", "negrilla", "negrura", "pringue", "tizne"); *Physalospora citricola* Penz.; *Sphaerella Gibelliana* Pass.; *Melanomma medium* Sacc.; *Pleosphaeria hesperidum* ("manchas de los frutos"); *Sphaerium Wolfensteiniani* Kühn ("mal de goma", "enfermedad del marango", "podredumbre de las raíces", "gangrena"); *Aposphaeria sepulta* Penz.; *Collectotrichum gloeosporioides* Penz.; *Oospora hyalinula* Sacc.; *Penicillium glaucum* Link.; *P. digitatum* Sacc.; *Botrytis vulgaris* Fr.; *Echinobotryum Citri* Gar.; *Cladosporium herbarum* Link.; *Fusarium Limonis* Br.; *Rhizoctonia violacea* Tul.

The plant parasites most dreaded by the agriculturist are those causing "fumaggine" ("negrilla") and gummosis ("mal de goma").

Spraying is carried out by means of a syringe. The following well known formula is used :

Black soap	1 kg.
Ordinary petroleum	4 litres
Pure water	100 litres

The soap is cut up into small pieces and dissolved in a few litres of boiling water. The petroleum is added gradually, stirring all the time; in this way, a kind of thick cream is obtained which before use must be diluted with water, according to the above formula.

Gummosis is usually controlled by cutting the main root of the orange-tree and uncovering the large roots to a distance of 25 cm. from the trunk. A circular trench is dug round the tree to prevent the irrigation water reaching the trunk. Some growers combat this disease by the application of powdered iron sulphate every three, four or five years. This substance is spread on the soil at the rate of 600-1200 kg. per hectare and dug in like an ordinary chemical fertiliser. Many insects attack orange and lemon trees, but only a few are injurious.

The larval forms of some insects attack and seriously injure the roots, sometimes even killing the tree. *Otiorynchus meridionalis*

Schoenh., when present in large numbers does damage and the same may be said in regard to ants.

Among the parasitic microlepidoptera may be mentioned *Acrolepia citri* Mill. and Rag. which attacks the orange and lemon flowers; *Albinia gnidiella* Targ. and *Eupithecia pumilata* Hbr.

The diptera causing really serious damage include *Halterophora hispanica* de Brême, also known as *Ceratitis hispanica* de Brême, *Ceratitis capitata* Wied. (popularly called "mosca del naranjo"), "barrina", "barreneta", or orange-fly). This parasite has been studied by experts sent from North America, as is shown by *Bulletin* No. 640 of the United States Department of Agriculture (Washington, 1913), entitled the "Mediterranean Fruit Fly", and written by E. A. BACK and C. E. PERBERTON.

Insecticide sprays have been recommended for the control of this parasite, but as a matter of fact, farmers rely on the effectual aid of the many hyperparasitic insects which abound in Spain.

One of the aphides most destructive to both orange and lemon-trees is: *Aphis aurantii* Bor., also called *Toxoptera aurantii* Kock, or *Siphonophora citrifolia* Asin, or *Aphis* sp. Kal., popularly known in Spain as the "pulgón del naranjo", or "piojo verde". This is combated with petroleum and soft soap, sulphur, solutions of Lysol, "zotal" polysulphides etc.

Other insects attacking the orange or lemon trees are *Aspidiotus ficus* Coms., *Aspidiotus limonis* Signer, *Aonidia aurantii* Targ., also known as *Aonidia gennadii* Targ., *Aspidiotus citri* Coms., *Aspidiotus aurantii* Mask., *Aspidiotus coccineus* Gen. and popularly called "cochinilla gris".

The discovery of two other insects, *Diaspis monserrati* Colvée, and *Diaspis colveei* is due to Dr. Pablo COLVÉE ROUVA.

One of the most destructive parasites of the orange and lemon-tree is the "serpeta"; this name is given by Spanish citrus-growers to several species of *Mytilaspis* but is usually applied to *M. citricola* Coms., also known as *M. flavescens*, Targ., *M. anguinis* Boisd., and *M. fulva* Targ.

Less injurious than the "serpeta" is the "piojo rojo", or "pollroig" (*Chrysomphalus dictyospermi* var. *pinnulifera* Mask.). This insect was the cause of the American method of hydrocyanic fumigation being introduced into Spain to combat citrus parasites; formerly, liquid insecticides were applied and they are still often

PLATE V.



FIG. 1. Panoramic view of the range of the Mount Conscience Peak in the San Salsador Mountains, W. of w.
C. C. P. and Adell.

PLATE VI.



FIGURE 1. Aerial view of the mouth of the St. Lawrence River, showing the large, dark, irregular shape in the center of the river.

used against "serpeta" and pollroig. The following are examples of the formulae employed:

Beniaján's formula.

Pine resin	1.562 kg.
62 % Caustic soda	0.625 »
Whale oil	0.234 »
Water	100 litres

Javali's formula.

Pine resin	3.333 kg.
Caustic soda	0.669 »
Water	100 litres

Formula of J. M. Martí Sanchis (Agricultural Engineer).

	<u>First formula</u>	<u>Modified formula</u>
Heavy tar oil	1.5 kg.	1.00 kg.
Whale, or fish-oil	2.0 »	1.34 »
Whale or fish oil soft soap	1.0 »	1.67 »
Caustic soda of 95 % purity	0.3 »	0.30 »
Water	96 litres	97 litres

The two last emulsions are prepared as follows: Dissolve the soda and the soap in 4 litres of hot water, stirring all the time till they are completely dissolved. Then add the tar oil, and lastly the whale oil, taking care to stir the whole well, so that it may be thoroughly mixed, finally add the water up to 96 or 97 litres. The mixture must be well-stirred each time before using and applied at once, for if left to stand, it loses its homogeneity.

Among the coccids accompanying the fungi producing the diseases known as "negrilla" or carbón, the most important are: *Coccus hesperidum* or *Lecanium hesperidum* also called "chinche del naranjo", "cochinilla roja", "poll", "piojo" and pulgón del naranjo (citrus scale) — *Lecanium oleae*, or *Saissetia oleae* — *Dactylopius citri*, or *Pseudococcus citri* popularly called "cochinilla blanca", "piojo blanco" and "cotonet poll" (cottony citrus scale) which is

controlled, like the preceding coccids, by insecticides with a base of petroleum, soda, soft soap, fish oil etc., and fumigations with hydrocyanic acid, but owing to the white downy substance covering the parasite, it is difficult to destroy the pest.

Other parasites are: *Parlatoria lucasii* Targ., also called *Parlatoria zyziphi* Sig., and *Chermes aurantii* Boisd. popularly known as "kermes del naranjo" and "cochinilla negra" ("zizifo parlatoria") — *Parlatoria pergandi* usually found with the preceding insect — *Ceroplastes rusci* Signor (syn.: *Coccus rusci* L.; *Lecanium rusci* Wack; *Kermes rusci* Boisd., *Calypticus radiatus* Cos., *Columnnea testudiniformis* Targ.).

A few years ago, the "cochinilla australiana" or "cochinilla acanalada" (*Icerya purchasi* Maskell) accompanied by its parasite *Novius* (*Vedalia*) *cardinalis* found its way into Badajoz from Portugal. The "cochinilla australiana" threatens to invade the orange-gardens, and attack crops in East-Spain, where it was apparently introduced, from France (according to the Staff of the Ministry of Agriculture) with some acacias, in the spring of 1922 by a nursery man named Veirat. Although colonies of *Novius* (*Vedalia*) *cardinalis* already exist in the district, the coccid does not appear to be sufficiently controlled by its parasite, as has recently been found in Badajoz by Leander NAVARRO, Director of the Phytopathological Station at the Alfonso XIII Agricultural Institute, in Madrid.

It would be possible to give a much longer list of the insects that attack orange and lemon-trees, but it will be sufficient to add that some mites (*Rhizoglyphus* and *Tetranychus*) are often found injuring these plants. Numerous colonies of *Oribatula plantivaga* also occur but these insects are regarded as useful.

To the injury caused by animal and plant parasites must be added the damage occasioned by frost, hoar-frost, severe cold, hail, snow, excessive moisture, or drought.

The following is an old Valencian formula used against plant-lice and coccids:

- 13.25 litres very hot water.
- 1 kg. soft soap.
- 1.25 kg. Solway soda.
- 1 litre ordinary petroleum.

Dissolve the soap in 13.25 litres of water, stirring vigorously all the time, add 1.25 kg. Solway soda, mix well; then add the pe-

troleum gradually, stirring all the time. This mixture can be kept some time, and only needs stirring well just before use. When the mixture is required, 1.75 litres should be dissolved in 16 litres of pure water and stirred well.

In order to clean the trunks and branches of orange and lemon during the winter, 11 lb. of the first mixture can be dissolved in 50 litres of water and applied, care being taken to stir thoroughly.

A brief summary is given of two popular articles published in the daily press. The first deals with the continually increasing damage occasioned by "serpeta", and appeared in April 1914 in the newspaper, *Las Provincias* of Valencia. The article bears the title "La Serpeta, plaga del naranjo", it is by Dr. Pablo COLVÉE ROURA and contains 5 figures.

The "*pidocchio a virgola*" a parasite of the orange tree. The "serpeta", "*pidocchio a virgola*", a hemipteron belonging to the coccid family, is a member of the genus *Mytilaspis*. The authors who have described it do not agree as to its scientific name. Thus, TARGIONI calls the insect *Mytilaspis fulva* and *M. flavescens*; PENZIG designates it *M. citricola* and PACKHARD and COMSTOCK give it the name of *Aspidiotus citricola*.

The parasite appeared for the first time in Spain, at S. Vincente de Sarria, about 1870, and this place was the centre of infection from which the insect spread to the orange gardens of Mataró, Agell, Tiana, Agelli etc., where it did great damage, though the matter was little known, owing to the small size of the plantations.

In 1894, the pest made its appearance in Castellón. On enquiry, it was found to have been introduced from Mataró (Catalonia), in young trees that had been imported thence, either from motives of economy, or on account of an insufficient local supply. It should be noticed that the importation of young trees was continued until about ten years ago and then ceased, which shows that the presence of "serpeta" was at first unobserved. The disease therefore appears to be very slow in developing, and if recognised in time, could probably be stopped, or at least prevented from spreading. This malady does not form infected patches in the citrus plantation like phylloxera; beside severely injured trees, other individuals are often seen which seem perfectly healthy, although infested with thousands of insects.

M. flavescens occurs on all the aerial parts of the tree but by preference on the branches and twigs. The parasite is protected by a small hard, scaly plate that is so impermeable as to protect it against

all insecticides, whether in the powder, or liquid form, unless these are applied during the short period in which this natural shield is in process of formation.

The parasite resembles a snake in shape, hence its popular name of "serpeta" (little serpent).

Instead of giving a detailed anatomical description of the insect some biological data are added, to assist in the selection and application of the treatments.

The larvae have very limited powers of locomotion, and are only able to pass from one part of the tree to another; they cannot reach another tree, except by the agency of the wind. The females are incapable of moving, so they have no power of spreading the disease. The males are winged and can fly long distances. The parasite enters the active phase at the beginning of spring, at this time, the small larvae crawl about the tree till they find a suitable spot, when they insert their rostrum into the epidermis and never move again. They at once set about making their shield which at first is very permeable. They moult twice, and after the second moult, the eggs begin to develop in the body of the female which they completely fill. The eggs remain covered by the shield of the dead female until the temperature causes them to hatch out.

The complete cycle lasts, according to COMSROCK 80 days, though in some cases, it may be one or two weeks shorter. This refers to the first, spring generation, but there are many successive generations from March-April to May that enormously increase the number of individuals.

The insect injures the tree in three ways: 1) by sucking the sap; 2) by occupying a large part of the surface of the tree and thus hindering the normal its functions; 3) by the excretion of a sugary substance encouraging the development of "fumaggine" which in its turn contributes to weaken the tree.

The best means of controlling the parasite are therefore as follows

1) By the prevention of the presence in the citrus garden of any weak trees which are liable to infestation and have been reduced to this state by such causes as want of nutriment or excessive production.

2) By the avoidance of the introduction of young trees from infected districts, and should any have been already introduced, they should be rigorously examined, and if necessary, treated or removed.

3) If a centre of infection has been discovered, it is necessary to take different measures according to whether the infection is very severe or not. In the first case, the trees must be cut down and the branches, twigs and fallen leaves burnt on the spot. In the second case, it is enough to adopt the treatment termed "cultural" in the control of phylloxera, that is to say the spread of the insect should be checked by the destruction of the branches most seriously attacked. This ought also to be done in all cases where even a small number of insects are present.

Insecticides in the form of powder are almost useless; the solution that has given the best results is petroleum emulsion in water containing 2 or 3 % soap. The best time for treatment is as soon as the larvae hatch out and before their shields have become impermeable. Unless the trees are badly infested, it is sufficient to apply this mixture once in the spring and once again in the autumn so as to destroy the first and the last generations. By the adoption of this, and any other remedies that experience may suggest, it is possible to keep down the pest within reasonable economic limits, even where it has been already established.

After Dr. COLVÉE had written the article referred to above, "serpeta" continued to invade the Spanish citrus gardens to such an extent as to become a veritable scourge, but modern control methods and the use of hydrocyanic acid, have provided the agriculturist with most effective weapons that were wholly unknown in the days of Dr. COLVÉE.

The second article mentioned was published in *El Mercantil* of Valencia. It was written by Dr. Ricardo GARCIA MERCET and treats of the damage done by *Chrysomphalus dictyospermi* var. *pinnulifera* Mask., the "poll roig" of the Valencians. GARCIA's article is much more recent than COLVÉE's as it appeared in December 1910.

The following is an abstract:

The control of "poll-roig".

The name "piojo rojo del naranjo" seems to be given to three different insects in Spain: *Chrysomphalus pinnulifera*, or true "poll-roig", *Aspidiotus hederae* or "piojo de la yedra" and *Aonidiella aurantii* which seems to have no popular name. These three coccids all form a circular shield over the portions of the plant they attack and are very much alike, but distinguishable at first sight from the coccids with a more or less rod-shaped shield such as "serpeta" (various species of *Mytilaspis*). *Chrysomphalus*, *Aspidiotus* and

Aonidiella are not only easily mistaken for one another on account of the structure of their shields, but also from the similarity of their larvae, nymphs and male forms. They can only be distinguished by the microscopic examination of the adult females. These, in the cases of *Chrysomphalus* and *Aspidiotus* have wax like discs around the vulva which are absent in *Aonidiella*. The females of *Chrysomphalus* and of *Aonidiella* bear appendages (paraphyses) on the edge of the last abdominal segment, these structures are not present in *Aspidiotus*. The three species also differ somewhat in the shape and colour of their shield which is elongated in *Aonidiella*, circular in *Aspidiotus* and *Chrysomphalus*; pinkish in *Chrysomphalus*, and yellowish or whitish in *Aspidiotus*. When *Aspidiotus hederae* occurs on the orange-tree, its shield however, assumes a darker hue, while on the ivy, the shield of *Chrysomphalus* becomes broader. The two first species are very wide-spread in the district of Valencia, the third is much rarer.

As regards the method of controlling these pests the author considers the "natural" system to be the best, which consists in encouraging the propagation of the enemies of the parasites. Two of these are already known, the small beetles, *Chilocorus kuwanae* and *Rhizobius lophantae*; their larvae live on the eggs of coccids as has been discovered by observations made on the scale-insects of the orangetree in the Laboratory of Agricultural Entomology at Portici (Italy).

In this connection, it is well to mention that no serious campaign must be undertaken against insects present in the orange-gardens until it has first been distinctly proved that the species is injurious. Among the insects that our citrus-growers attempt to destroy is *Chilocorus bipustulatus*, which should be protected in every way, since its larvae live on coccids. In order to prevent such mistakes it would be advisable to exhibit collections of the useful insects in the district, so that they might be easily recognised, and thus be sure of protection. In addition to *Chilocorus bipustulatus*, two others, *Exochomus 4-pustulatus* and *Rhizobius litura* also exist in the region of Valencia. It is thus necessary to encourage the development of all hyperparasitic insects, whether endophagous or ectophagous; the latter should be especially protected, as they are the more useful.

After M. R. GARCÍA MERCET had written the article summarised above, "Poll roig" although a destructive insect proved to be less injurious than was expected on its first appearance in East Spain.

There is no doubt that the natural enemies of the coccid had proved most useful allies in checking its spread.

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AGRICULTURAL INTELLIGENCE

AGRONOMY

Agricultural Meteorology.

1. **The Weather and Crops in Eastern England, 1885-1921.**

HOOKER, R. H., in *The Quarterly Journal of the Royal Meteorological Society*, Vol. XLVIII, No. 202, pp. 115-138, tables 3 London, 1922.

An article entitled "Correlation of the weather and crops" written by the author appeared in the *Journal of the Royal Stat. Soc.*, Vol. 70, p. 1 (1907), dealing with a period of 21 years. In the present article the results of further work on similar lines are recorded, but the material accumulated covers the longer period of 1885-1919. This is sufficiently long to permit the elimination of any factors that may be due to cyclical causes, and in particular any effect of a Brückner cycle.

The area concerned includes the countries of Middlesex, Hertford, Essex, Suffolk, Norfolk, Cambridge, Huntingdon, and Lincoln. The yields per acre are tabulated from data given in the annual Agricultural Returns. The climate is very uniform in this district. The rainfall and temperature data are taken from the *Weekly Weather Reports* of the Meteorological Office, and the accumulated temperature above 42° F of the meteorological district known as "England East".

Both total and partial correlation coefficients have been calculated in the usual way, and all deductions are drawn from consideration of the latter, the effect of the rainfall and temperature being eliminated.

The coefficient 0.5 and over is regarded as satisfactory evidence of close dependence of crop yield upon the weather at a period indicated, and 0.25 and over as indicating probable dependence.

The author correlates the calculated yield with the total rainfall and temperature above 42° F in 8-week periods, from March to October of the following year (1st-8th weeks; 5th to 12th weeks; 9th-16th weeks, etc.).

The results are given in diagrammatic form and also tabulated. (see table pag. 76).

The following outstanding facts are to be observed :—

1) A strong negative correlation coefficient with rain in October, the sowing period, and the yield (137-144 week). According to the author this may be attributed to a purely mechanical effect, such as the clogging of the soil that prevents the proper development of the root system.

TABLE I. — Correlation Coefficients between Weather and Crops.
(*Eastern England*).

Period	Rainfall	Partial	Temperature	
	Correlation Coefficient	Correlation Coefficient	Correlation Coefficient	Partial Correlation Coefficient
<i>Previous years :</i>				
9th-16th week	- 0.06	0.06	0.00	- 0.02
13th-20th »	- 0.14	- 0.16	0.00	- 0.06
17th-24th »	- 0.11	- 0.06	0.14	0.00
21th-28th »	- 0.39	- 0.37	0.15	0.03
25th-32th »	- 0.31	- 0.26	0.21	0.12
29th-36th »	- 0.16	- 0.01	0.32	0.26
33th-40th »	0.39	- 0.21	0.40	0.23
37th-44th »	- 0.56	- 0.41	0.35	0.17
41th-48th »	- 0.34	0.33	0.29	0.28
45th-52th »	- 0.05	- 0.05	0.23	0.23
49th- 4th »	- 0.19	- 0.23	0.13	0.18
1st- 8th »	- 0.50	- 0.50	0.25	0.26
5th-12th »	- 0.33	- 0.33	0.20	0.20
9th-16th »	0.03	0.06	0.07	0.09
13th-20th »	0.13	0.02	- 0.21	- 0.17
17th-24th »	0.26	0.09	- 0.41	0.34
21th-28th »	0.05	0.01	- 0.12	0.11
25th-32th »	- 0.27	- 0.27	0.07	- 0.02
28th-36th »	- 0.34	- 0.37	0.05	- 0.16
33th-40th »	- 0.13	- 0.11	0.08	0.00
37th-44th »	0.17	0.21	0.13	0.22
<i>Seasons :</i>				
Previous Spring	- 0.18	- 0.14	0.13	0.07
Summer	- 0.30	- 0.20	0.29	0.20
Autumn	- 0.52	- 0.45	0.37	0.24
Winter	- 0.42	- 0.48	0.23	0.34
Spring	- 0.31	0.23	- 0.33	- 0.25
Summer	- 0.34	- 0.37	0.01	- 0.16
Whole Period	- 0.64	- 0.63	0.15	0.05

(1) It should be understood clearly that the data refer to the partial correlation coefficient dependent on certain meteorological factors, after elimination of the concurrent forces and contrary to other factors. Thus for the period 37th to 44th week inclusive, we have a total negative correlation coefficient from the rainy period to the harvest, equal to -0.56. This indicates that the excess of rain corresponds with a decrease in crop yield. During the same period the positive coefficient remains comparatively high between temperature and yield, which increases with rise in temperature. At present the latter usually decreases much more markedly than the rainfall, in such a way that the negative coefficient between rainfall and harvest during the period under observation, becomes apart from direct action, deleterious to the rains, also to the beneficial effect of the temperature, and the direct relative effect of the rainfall, which in the present case equals -0.49. The partial correlation coefficients have naturally the greatest importance. (*Ed.*)

2) A strong negative correlation is evident with rain during the winter and the consequent washing out of the soil nitrates (1st to 8th weeks).

3) There are two other periods when dry weather appears to be required: a) the early summer of the preceding year, when the seed to be sown in the ensuing autumn is forming; b) in late summer, just before the harvest.

As regards temperature coefficients, the complete contrast between the two halves of the diagram is very striking. To secure a high yield requires apparently a warm autumn and winter, whereas it is desirable that the early summer in the year of harvest should be cold, and later in the ripening period, warmth is required.

The author considers, that other things, being equal, seed-wheat should preferably be obtained from a warmer district, and adaptable to the maximum germinating power.

The following crops were also studied.

1 BARLEY — The negative coefficient with rainfall and yield is accentuated during winter before the sowing period (49th to 54th weeks $r = 0.46$; 1st to 8th weeks $r = 0.48$; 5th to 12th weeks $r = 0.32$). Dry and mild weather is essential at sowing time, and a cool and dry spell to facilitate cultivation as excessive rainfall has an unfavourable effect on the texture of the soil.

The injury, however, resulting from rainfall during the setting period, seems instead to represent a positive coefficient with reference to the rainfall at the end of the spring (1).

With reference to the area concerned, the rainfall is liable to exceed the requirements. The most important requisite for a good barley yield is cool weather during summer — during the four months from May to August. The correlation coefficients recorded for periods 17th-24th weeks; 21st-28th; 25th-32nd, and 29th-36th are negative viz. -0.58 ; -0.40 ; -0.34 and -0.40 respectively.

In the east of England, the temperature appears to meet requirements for the production of seed of good quality, but is usually too high for abundance of crop.

OATS. — Requirements are on the whole very similar to those of barley with the exception that far more rain is required in the late spring. There is a negative coefficient between yield and temperature; cool weather from April to August is essential.

BEANS. — The largest coefficient is negative with temperature, about May to July. The data given indicates: 1) that for quality of seed, dry weather in the previous spring is important, moderate warmth in early summer, and absence of rain in the late summer; 2) that for quantity the sowing period should be dry (but not warm as for wheat), the winter should be warm, and there should be rain in spring.

PEAS. — A temperature curve similar to that of beans is found.

(1) In all probability coinciding with the critical period as regards soil humidity, the critical period which occurs just before the earing stage (Ed)

POTATOES. — To obtain good seed tubers, a moist cool summer is required, and rain about planting time (April-May) followed by dry weather and warmth about May-June. High coefficients indicate also that the yield is helped by warm, rainy weather in the latest stages (October).

TURNIPS AND SWEDES. — These crops demand rain in June and cool weather from June to September.

MANGOLDS. — This crop is sown earlier than turnips and the negative coefficients with rainfall and temperature about February and March are doubtless indicative of a fine tilth. The entire spring and summer should be cool, whilst a mild autumn and absence of frost favours the swelling of the roots.

HAY. — The dominant feature is the absolute necessity of rain in the spring; the high coefficients are in fact an outstanding feature. A cool late spring and an early summer favours heavy crop production.

The main periods have now been indicated although, however, there are many cases when the coefficient may be low and constant. The problem is in every case complicated and demands further and more detailed investigation.

The author has taken the opportunity to work out the regression equation in all cases where the correlation coefficient was above 0.25, in order to see what effect each successive period of the year has had upon the crop yield.

To obtain a definite idea in order to determine specifically the position, it is important to draw special attention to the years in which the yield has been exceptionally high or low. In the case of barley, the best crop of all, 5.2 bus. above the average in 1885, was due to the unusual combination of a cool and also a dry summer. The worst crop was that of 1893 for which the hot spring and early summer were clearly responsible. The poor crops of 1915-16 are attributed to wet winters, and those of 1917 and 1919 to a hot May and June.

The charts agree with former reports in relation to correlation coefficients. The author, however, gives data relative to other cultivated crops and emphasises the need of further investigations on this important problem.

G. A

2. Effect of Climatic Conditions on the Development and Productivity of "Champagne" Maize in S. Simão (S. Paolo) Brazil.

XAVIER, R. Effetto dei fattori meteorologici sullo sviluppo e la produttività del mais Champagne a S. Simão, Brasile, in *Revista Mensal de Meteorologia* Vol. I. Nos. 3, 4 and 5, pp. 25-30. Rio de Janeiro, 1922

The author gives an account of results obtained in a series of investigations made at the Agricultural Meteorological Station of S. Simão (S. Paolo), with reference to the effect of climatic conditions on development and productivity of the "Champagne" maize variety. This variety is the result of a cross Crystal × Indian eclaro.

Four separate sowings were made on the 1st, 10th, 20th and 30th November and on four different plots.

Germination. — Seedlings were obtained in plots 1 and 3, five days after sowing, and in plots 2 and 4, six or seven days after sowing.

As regards the average maximum and minimum temperature, the total rainfall and the cloudy days, the following values are calculated for each period of the sowing and seedling stages.

	Temperature	Rainfall	Cloudiness
1st week of November	20.7° C.	11 mm.	5.9
2nd » » »	23.2° C.	14.2 mm.	6.2
3rd » » »	24.5° C.	7.3 mm.	5.5
4th » » December	23.0° C.	59 mm.	5.8

Leaf development. — The formation of the leaves was notified in the second half of December, and the first week of January. The corresponding data are as follows:—

	Temperature	Rainfall	Cloudiness
2nd week in December	24.4° C.	43 mm.	6.5
3rd » » »	22.0° C.	127 mm.	7.9
1st » » November	24.6° C.	130 mm.	7.0

Towards the end of this period and for each plot the following biometrical data are estimated.

Plots				
	1	2	3	4
Width	17 cm.	16 cm.	14 cm.	12 cm.
Length { apex	240 »	200 »	117 »	90 »
{ apex and leaves	300 »	260 »	240 »	140 »

Flowering. — Noted during January following the order of time of sowing.

	Temperature	Rainfall	Cloudiness
2nd week in January	22.0° C.	67.9 mm.	8.0
3rd » » »	23.7° C.	102.1 mm.	8.2

Setting of fruit. — During the first week of February with the following meteorological values: 25.7° C, 19.0 mm. and 5.9. The average length to the apex including the terminal inflorescence was at this stage equal to 3.50, 3.30, 3.00 and 2.90 metres in plots 1, 2, 3 and 4 respectively. The effect in plot 4 appeared to be identical to the rest.

Development of the ears up to ripening period. — The second and third week of February and the first week of March.

	Temperature	Rainfall	Cloudiness
2nd week of February	25.0° C.	53.0 mm.	6.1
3rd " " " 	23.6° C.	36.0 mm.	7.0
1st " " March	2.2° C.	110.0 mm.	8.9

In the first week of March, with the exception of plot 4, the ears were produced normally up to the beginning of the ripening period.

Average ripening period. — The second week of March, the plants on plot 1, started to ripen, whilst the others were delayed until the third week.

	Temperature	Rainfall	Cloudiness
2nd week of March	23.8° C.	77.2 mm.	6.3
3rd " " " 	23.3° C.	45.1 mm.	7.6

Final ripening and yield. — Ripening was completed in the first week of April on plots 1 and during the second week for the other plots.

The most satisfactory results were obtained in plot 3, sown on November 20, followed by plots 4, 2 and 1.

	Plots					
	1	2	3	4		
Number of superior quality ears	75	84	95	90		
" " inferior " " 	25	20	10	15		
% superior quality ears	75 %	80.7 %	90.4 %	85.7 %		
Weight in kg {		sheath + cob	21.0	22.0	24.6	25.0
		leaves + stem	21.4	32.4	36.4	38.6
		grain	11.0	12.0	13.4	12.2
Total	53.4	66.4	74.4	76.0		
% of dry matter	20.5 %	18 %	18 %	16.1 %		
Coefficients	1.0	1.10	1.22	1.20		

G. A.

3. Forecasting the Cold Wave in Brazil.

SAMPAIO FERREZ in *Revista Mensal de Meteorologia*, Vol. 1, Parts 3, 4 and 5, pp. 37-44 + figs. 2. Rio Janeiro, 1922.

A cold wave is understood to mean a rapid fall of temperature within a short space of time; this term is applied in the United States to a fall of 16°-20° Fahrenheit in 36 hours, but the values are conventional, being arbitrarily chosen and hence vary in different countries. The phenomenon is connected with the presence of anticyclonic areas causing the descent of great masses of cold air thus increasing the radiation from the earth.

Cold waves are of relatively frequent occurrence in the Southern States of the Federation, where they cause considerable injury to agriculture. The anticyclonic area which is preceded by a continental depression extending from the South of Matto Grosso, to the north or centre of Argentina, travels from the interior towards the Atlantic between parallels 15 and 30 South latitude and is accompanied by a cold dry wind from the West and South-West. No cold wave is however experienced when, on the contrary, the high pressure system does not take its habitual course but passes more to the south towards the Atlantic and follows the estuary of the Rio della Plata, and then turns in a North-East direction, and drifts along the Brazilian coast-line.

With the aid of consecutive, serial, synoptic charts for South America, a cold wave can be relatively easily forecasted two, or even, three days in advance.

The following is a description of the typical arrangement of the isobars during the three days preceding the arrival of the wave.

1) An anticyclonic area in South-West Argentina and another which is already in process of shrinking in South-East Brazil. Between the two systems two cyclone-form, one in the Atlantic along the coast of Argentina, and the other inland between Argentina and Matto Grosso.

2) The Argentine anticyclone rises decidedly towards the north, while the continental depression rapidly becomes less; at Bella Vista and other point to the extreme south of Matto Grosso, there appear the first sign of the advancing anticyclone. The Atlantic depression remains unaltered, while the continental depression continues to detach itself.

3) As the pressure conditions on the coast remain unchanged, the anticyclone rapidly develops over Matto Grosso and directs its course steadily towards the Atlantic. On the fourth day, the cold wave invests the whole region as far as Espírito Santo and purifies the atmosphere, keeping the temperature down, or making it fall still further.

The pressure of the cold wave if supplemented by local data could be of great service to agriculture, as with this warning it would be possible to make the arrangements necessary to prevent, or diminish, the effects of the phenomenon.

G. A.

4. Control of Frost Attack in San Paulo (Brazil.)

BERLINCK, E. L. La lotta contro le gelate nello Stato di S. Paulo (Brasile), in *Revista Mensual de Meteorologia*, Vol. I, Nos. 3, 4 and 5, pp. 33-36. Rio de Janeiro, 1922.

Frost occurs frequently and causes a certain amount of damage to the coffee plantations in San Paulo, especially in the provinces of Campinas, Ribeirão Preto, Jahu and S. Carlos.

An example is given of a planter, José FERREIRA DO AMARAL, who working entirely in his own way with the help of meteorological instruments has succeeded in successfully controlling the damage by means of smoke derived from the burning of leaves of maize soaked in tar. The author takes the opportunity to encourage farmers to adopt control

[4]

measures and to support the issue of forecasts which will give notice of the approach of cold weather.

The Central Meteorological Station under the direction of SAMPAIO FERRAZ intends in fact to extend its issue of weather forecasts in the most fertile districts in the south which are liable to frost, with a view to the methodical organisation of control measures.

G. A.

Pedology.

5. Soil Acidity.

HISSINK, D. J. and SPEK, J. in *Verslagen van Landbouw Onderzoekingen der Rijkslandbouwproefstations*, No XXVII, pp. 146-161. Gravenhage, 1922.

The following factors are specified in relation with soil acidity: carbon dioxide, calcium carbonate, argillaceous material, humus (in certain soils acid sulphates are found which may render the soil very acid, to the extent of pH²).

A saturated solution of carbon dioxide gives a pH value of about 4; the effect of carbon dioxide on soil acidity is probably small.

A solution of calcium carbonate possesses a fairly high alkaline reaction. In soils containing calcium carbonate an equilibrium is established between the calcium carbonate, the carbon dioxide and the humus. This equilibrium is not easily calculated even if the exact figure with reference to humus are at hand. It can only be stated definitely that the soil water containing calcium carbonate possesses a slight alkaline reaction.

Clay soils which lack calcium carbonate and humus show always a slight acid reaction or are faintly alkaline. The author attributes this reaction to aluminio-silicic acids, derived from the clay material, these possess a very weak acid value, pH 6.4 - 7.4.

The humus produces a more acid reaction, about pH 4. Contrary to argillaceous acids, the humus decomposes the calcium carbonate at normal temperatures.

The author has determined the acidity of several types of soil in the Netherlands. Certain peaty soils (with a high humus content) and other peaty-sandy soils possess an acid reaction value equal to pH 4 varying to a weak alkaline reaction pH 7.1. The soil from the dunes has a pH value up to 4.

The clay soils, rich in humus, gave an acidity value of pH 5 to 5.5, which showed a reduction according to the lime content. Those lacking in humus are less acid, pH 6.4 to 8.0 (sandy-argillaceous).

The author expresses his surprise that apparently a tacit agreement exists between investigators occupied with this question that the most desirable reaction of the soil would be neutral, or very slightly alkaline, for all soils and all plants. Several soils analysed by the author are of an excellent texture, e. g. that from dunes would be suitable for flowers (narcissi, tulips, hyacinths, etc.). The best narcissi are found on the most acid soils, pH 4.

Reference is made to the "buffer" value of the soil. When caustic

soda is gradually added to an acid solution, the acid concentration is changed continually, but irregularly, and there is a point when there is only a slight variation in acidity on the addition of considerable quantities of acid or alkali. This point is termed the "buffer value". It would be of interest to ascertain if a "buffer" point exists also in soil acidity and if this is the case a comparatively fixed value of pH would be determined by the addition of acid or alkali to the soil. The author has experimented with an artificial humus with a buffer value of pH 6 and another of pH 10 to 11 and these experiments are still in progress. D. V. S.

6. The Reactions of Soils in Italy.

PRATO LONGO (Laboratorio di Chimica agraria della R. Scuola Superiore di agricoltura di Milano) Studi e ricerche sulla reazione del terreno *Giornale di Chimica industriale ed applicata*, Year IV, No. 11, Vol. 41, pp. 517-521, Milan, 1922.

The inorganic alkalinity and acidity of soils. The great majority of soils derived from recent formations have a neutral reaction. On account of the action of water and substances in solution, and the successive oxidation and reduction, whether the changes are inorganic or organic, the soil does not retain its original reaction. The basic carbonates and silicates dissolve, to a greater or less extent, in the rainwater or irrigation water, in the form of calcium bicarbonate.

The bicarbonate in solution reacts in the soil and the calcium changes place with the sodium, potassium, magnesium or ammonium, etc.; there will be thus, a more or less distinct alkaline reaction. Under specially unfavourable condition the limit of solubility of the carbonate of soda may be reached, for instance, in the case of the naturally sterile, efflorescent, saline "alkali-soil" of America. In Italy the reaction does not go so far. Rain water rendered acid by atmospheric carbonic or nitric acid, reacts on the soil in such a way that the hydrogen-ion is absorbed and fixed by the soil, from which, in exchange equivalent amounts pass into solution of calcium, sodium, potassium, magnesium etc. In consequence, the soil water acquires an alkaline reaction and the soil loses little by little its calcium, sodium, potassium and magnesium and gains hydrogen. The same result is brought about by irrigation. Under such conditions of acidity the soil reacts with the alumina and oxide of iron, which are partially dissolved and, owing to hydrolysis, cause an acidic reaction. The variations in the degree of dilution and in the decomposition of the soil, the variations in the amount of rain or irrigation water, the methods of cultivation etc., may easily cause the soil to be either acid or alkaline. However, the capacity to reduce the pooriness and aridity is further complicated by the processes which take place in the soil. Thus, oxidation and reduction of iron compounds are intimately connected with soil reaction. This phenomenon is due to the different basic characters of the ferric and ferrous salts. Ferrous hydrate is a strong base; ferric hydrate has, so to say, no basic property; the effect of oxidation of ferrous and ferric hydrates is thus to lessen soil

alkalinity. For the same reason, the reduction of ferric hydrate corresponds to "deacidification of the soil".

However, a soil which has been deacidified in this manner will remain sterile for cultivation because the power of reduction is still a strong cause of sterility.

Acidity is thus, so to say, maintained potentially and reappears whenever oxygen again forms ferric hydrate. In practical cultivation the phenomena of reduction and oxidation have been verified by the change in colour of the soil from a bluish tint to brown.

The author then alludes to the degree of soil reactions. He gives a series of indicators which are specially suitable for experiments on the reactions of the soils of Italy.

Indicators	Zone of increasing pH value
1. Bromophenol blue	3.0 — 4.6
2. Methyl red	4.4 — 6.0
3. Bromocresol purple	5.2 — 6.8
4. Bromothymol blue	6.0 — 7.6
5. Phenol red	6.8 — 8.4
6. Cresol red.	7.2 — 8.3
7. Phthalein-cresol	8.1 — 9.8

The soils in Italy were classified as follows :

	degree of acidity	type of soil
Acid soils	peracid soils	heath
	acid "	organic
	subacid "	turf
Neutral soils	6.5 — 7.5	(fertile soils)
Alkaline soils	subalkaline soils	loam
	alkaline "	calcareous
	peralkaline "	alkali-soil

The author then gives a description of the soils with their bacterial flora and vegetation. A degree of alkalinity of 7 to 8 is not harmful.

An alkalinity of 8-9 prevents all bacterial action; the soil burns up all plant residues and organic manures. There are certain American vines such as, *Riparia*, *Aestivalis*, *Cordifolia*, etc. which have been introduced into Italy and which are very sensitive to alkaline conditions.

The vine-growers have until now supposed that vine chlorosis was caused by an excess of lime in the soil. As this carbonate is insoluble and in consequence, inert, it could not be harmful. The author attributes chlorosis entirely to the degree of alkalinity of the soil. A slight degree of acidity, 6-7, is not, as a rule, harmful. An acidity of 5-6 is sufficient, however to reduce bacterial activity to such a point that plants are affected. When the acidity reaches 4-5 several important microbio-chemical processes are completely stopped, as for instance, nitrification and the fixation of atmospheric nitrogen by *azotobacter*.

The harm caused by acidity is thus directly due to toxicity, and also to the alteration in the supply of assimilable nitrogen. Amongst cereals which are more resistant to acidity are : rye, oats, maize and rice ; leguminosae such as lupins and serradella and in the case of trees, chestnuts, cork-trees and the Scotch fr. In Italy there are large areas of land which have an abnormal reaction and a great deal of experimental work is necessary in order to ascertain how this may be corrected. Up to the present time, in the case of acid soils this has been done by the application of lime and marl and acidic fertilisers have been applied to alkaline soils.

The author recommends irrigation with hard water, which contains a large amount of lime in solution. D. V. S.

7. The Animals Living in the Plant Débris covering Forest Soil.

K. ESCHERICH, *Die Streufauna*, in *Forskwissenschaftliches Centralblatt, Organ für die Forstliche Abteilung der Bayer forstlichen Versuchsanstalt*, Part. I. Berlin, 1922.

One of the most important tasks of forest entomology is the investigation into the causes of those disturbances of natural economy that accompany great invasions of insects. The author undertook the study of the factors, of the relations existing between the animals living in the plant debris strewn over woodland soil and the effect they may have on the wood, according to whether they are useful, harmful, or merely innocuous, his object being to discover whether it is expedient to remove the superficial covering that harbours so many organisms. Amongst the work already done in this direction, the author mentions in the first place, the careful investigations of the Indian Dr. PILLAI, who for several years during the war, studied at the zoological section of the Bavarian Forestry Experiment Station, the fauna inhabiting the dry leaves and other plant remains strewn over the pine-woods.

PILLAI succeeded in experimenting upon a large quantity of material. This material was placed in an ingenious apparatus heated by an electric lamp of 200 candle-power ; the warmth induced the animals to leave their hiding-places and congregate in suitable glass pots where they could be easily watched. The results of these patient investigations were collected in tables and show that a great number of small organisms, some of them characteristic and others accidental, are to be found in the plant debris carpeting the soil of pine-woods.

Among the first are : nematodes, aptera, and acarians ; these occur in enormous quantities, there being often many thousand per sq. m., *Cecidomyia* larvae, several hundred per sq. m. ; and then in considerably fewer numbers (5-100 per sq. m.), *Arachnida*, *Annellida*, *Chilopoda*, *Formicæ*, *Diptera*, etc.

Many of these organisms, however, have little or no effect upon the well-being of the wood but some are injurious (*Lophyrus*) and others beneficial. The behaviour of a considerable number of species has yet to be discovered, and in many cases, the investigations have scarcely begun.

These investigations have also shown that the composition of these colonies varies according to the time of year, as would be expected. In June, there are fewer of these animals than in May; in July, the number increases and decreases again in September; in October it rises once more and then falls. The size of the colonies also depends upon the age of the woods, they are largest, and the monthly variations are greatest in mature woods.

The removal of the loose superficial layer naturally decreases the number of animals living in the woodland soil, the useful species being most reduced. PILLAI himself states, however, that the work hitherto done in this direction is not sufficient.

The author recognises the incompleteness of these studies of PILLAI'S, but draws attention to them as forming a valuable contribution to the solution of the interesting problem, and as a guide to carrying out, and profiting by the similar investigations now in progress on the plant debris strewn over the soil of fir and beech woods.

G. A. B.

8. The Mineral Constituents of the Soil in Sugar Cane Cultivation in Java.

PRINSEN GEERLIGS, H. C., in *De Indische Mercur*, Vol. XV, No. 42, pp. 719-720. Amsterdam, Oct. 20, 1922.

Very little mineral fertiliser is employed in sugar cane cultivation in Java, and what is used is almost exclusively nitrogenous. As the soil has a high potassium and phosphoric acid content, it is not necessary to supplement this in the form of fertiliser. In an article appearing in *De Taak*, 1922, No. 250, p. 1097, the Agricultural Advisor A. J. KOENS, states that the sugar factories obtain their profits at the expense of the soil. The author endeavours to justify this expense in the present article.

Growers of sugar cane let their land to natives once every three years. During the intermediate years the plantations are used for rice and palawidja. Profits from sugar cane amount to 90 fcs. per "bouw" (187.50 fcs. per 0.70965 ha. and to 20 fcs. (41.66 fcs) on rice or palawidja. KOENS claims therefore that rice returns are low owing to the fact that the sugar absorbed all the essential elements from the soil and has rendered it unfit for use for two years. The author considers, however, that other factors are responsible for the low rice yield, seeing that the "sawahs" where rice does not follow sugar in rotation, are equally unsatisfactory. In fact, the area occupied by sugar cane amounts to 5 % of the total area planted with rice and the sugar value thus obtained is equal to as much and even more than the entire rice crop.

D. V. S.

9. Soil Investigations in the Teak Forests in Java.

BAUMÉE-NIEUWLAND, N. *Mededeelingen van het Proefstation voor het boschwezen*, No. 8, pp. 1-91, bibliography. Weltevreden, 1922.

Chemical analysis of soils in the teak forests of Java.

The soils are variable in character; the majority of teaks are growing

on tertiary lime, but several fine forests are to be found on soils of volcanic origin with a low lime content.

Samples from four distinct types of soil were taken from three different layers in a pit 5 ft. deep:— 1) soil of calcareous origin; 2) calcareous; 2) red soil of volcanic origin; 4) red soil of calcareous origin

Estimations were made as to the phosphoric acid, potash, magnesium, lime, iron and aluminium contents, also the phosphoric acid soluble in 2 % citric acid.

The results of the analyses point to the following conclusions:

1 Red soils of volcanic origin contain no carbonate of lime. In the other soils of calcareous origin the content varies from 0 to 75 %. The highest percentage is found with soil taken from the greatest depth. Carbonate of lime is practically insoluble in water but is much more soluble in water containing CO_2 . The carbon dioxide due to root respiration, to micro-organisms, and to humus decomposition etc. is to be found in the surface layers. The carbonate of lime dissolves in the soil water of the upper layers and then passes to the lower layers where it is redeposited.

Type of soil	Depth	Ca CO_3
	from which collected cm.	
Red soil of volcanic origin (p. 45 Ngarengan).	15	0.0
	80	0.0
	200	0.0
Red soil of calcareous origin (p. 62 Koendoeren).	15	0.0
	70	0.0
	170	0.0
Soil of calcareous origin (p. 30 Mangger)	15	0.3
	60	22.4
	130	32.6
Mangger Teak plantation (starved)	12	24.8
	40	51.8
	110	74.7
Mangger Teak plantation (dying)	10	9.3
	25	33.2
	80	33.0
Monggot	2	28.0
	15	41.0
	100	27.5
Soil of calcareous origin (p. 50 Ngawen)	8	0.7
	30	0.1
	100	61.0

Although the exact part taken by calcium in plant development is unknown, its importance is undoubted. It is always found in the oldest parts of plants. Different authors claim that lime serves to neutralise the acids, especially oxalic acid which forms in the plant.

A comparison between the figures given in the above table indicate that soils with the highest carbonate of lime content give the most unsatisfactory results. Attention should therefore be turned to the physical

nature of the soil. The lime should exist in finely separated form, to facilitate plant absorption. The author has made analyses of the composition of the soils, and concludes that no direct relation exists between the chemical composition and the nature of the forests. The figures indicate that the reserve nutritive material in the teak forest soil is usually sufficient.

The author has also made a series of physical analyses of the teak forest soils, and in this way has formed estimates as to the moisture-retaining capacity of the different layers of soil.

If this capacity was greater in the surface layers than in the sub-layers finer forests were found, and vice versa. The numerous exceptions, however, do not permit any definite rule to be established.

The moisture content of the soils, was determined, but the results should not be taken to have any direct bearing on the quality of the forests.

The observations made as to the moisture permeability of the soil during plant growth, give an idea of the movements of water in the different layers. When there is a freer passage of water in the lower substratum than in the surface layers, a better quality of the forest is found.

In localities where the teak is dying out, it has been found that the permeability, in the substratum is invariably inferior to that of the surface layers, with the consequence that root decay was caused as a result of lack of air circulation, owing to stagnant water. The determination of soil permeability is thus of distinct practical benefit.

The factors which influence the grade of permeability have yet to be defined. Very calcareous soils appear to contain carbonate of lime, of a comparatively insoluble nature which prevents the soil from crumbling.

In order to make the carbonate of lime soluble and to improve the soil texture, it is necessary to increase the amount of carbon dioxide. With this in view it is considered advisable to leave the plant residues, leaves etc. lying untouched, and to avoid burning them. This layer of leaves acts as a protection against very heavy rains, and the choking of the sub-soil.

To improve soils evidently of very poor quality they should be left for some years unused, until covered with grasses which would increase the amount of carbonic acid in the soil and tend to decrease the alkaline reaction.

Recently, trials have been made with mahogany and teak intermingled in the forests.

D. V. S.

Fertilisers and Manures

10. The Value of the Waste Lime from the Cellulose Industry for the Fertilisation and Improvement of the Soil.

VON FEILITZEN, H. J. Vilket värde har avfallskalk från sulfatcellulosa-fabriker, s. k. kalkmesa som jordförbättringsmedel? *Kungl. Landbruks-Akademiens Handlingar och Tidskrift*, Year 71, No. 7, pp. 567-587, figs. 6. Stockholm, 1922

In the manufacture of cellulose by the so-called sulphate process, the saw-dust is boiled with a solution of sodium hydroxide and sodium sulphate.

When the alkalis are recovered, sodium sulphide is obtained, having been formed in the furnace by the reduction of the sodium sulphate, due to the action of the carbonised organic substance. The organic sodium compounds present in the lye are transformed into sodium carbonate. This "crude soda" forms caustic soda by the addition of slaked lime, which causes the hydroxide and sulphite of sodium to pass into solution. The calcium products are allowed to precipitate, and the lye is decanted off. The residues of calcium thus obtained consist for the most part of calcium carbonate, with a slight admixture of the hydrate and sulphate and traces of incompletely oxidised sulphur compounds (calcium sulphite, calcium trisulphate etc.); there are also a little hydrate and carbonate of sodium present.

The calcium residues are collected in large quantities by the factories, but have hitherto been little used for improving the land, because agriculturists have a prejudice against this substance, and appear so far, to have obtained no results by its use.

Since 1907, the author has been engaged in experiments with this waste lime at the Experiment Station of the Swedish Union for the cultivation of peat soils, and the results obtained are equivalent to those produced by slaked lime.

In order to have a larger number of comparative data at hand and at the same time to ascertain the amount of waste lime annually produced by the Swedish factories, the investigations referred to in the work under examination were carried out. They include: *a*) request made to all Swedish cellulose factories using the sulphate process to give the data required; *b*) the chemical analysis of average samples of waste lime from four different factories; *c*) pot tests of germination and cultivation with 2 different agricultural plants in which waste lime from 3 factories was used.

The results may be summarised as follows:

1) The 26 Swedish factories in which cellulose is made by the sulphate process, have at their joint disposal at the present time about 321 000 tons of waste lime (reckoned as anhydride) available for agricultural purposes.

As the calcium contains on an average 50 % oxide of calcium, this quantity corresponds to 165 500 tons of Ca O.

The annual production of waste lime in the factories is, in round numbers, 108 000 tons, equivalent to 54 000 tons of Ca O.

2) The lime waste of the cellulose factories employing the sulphate process is used only to a very small extent by agriculturists for liming the land. Good results have, however, always been obtained with it on the farms belonging to the factories.

3) According to the analyses made by Dr. O. BYGDÉN of the Chemical Division of the Swedish Central Experiment Station, the amount of the calcium carbonate in the calcium refuse of 4 factories, as found in samples and estimated as anhydride, ranged from 69 to 90 %. Calcium hydroxide made up from 2 to 11 %, and calcium sulphate from 0.03-1.67 %. In only one sample was more than 0.33 % of calcium sulphate found.

Among the incompletely oxidised sulphur compounds present in the

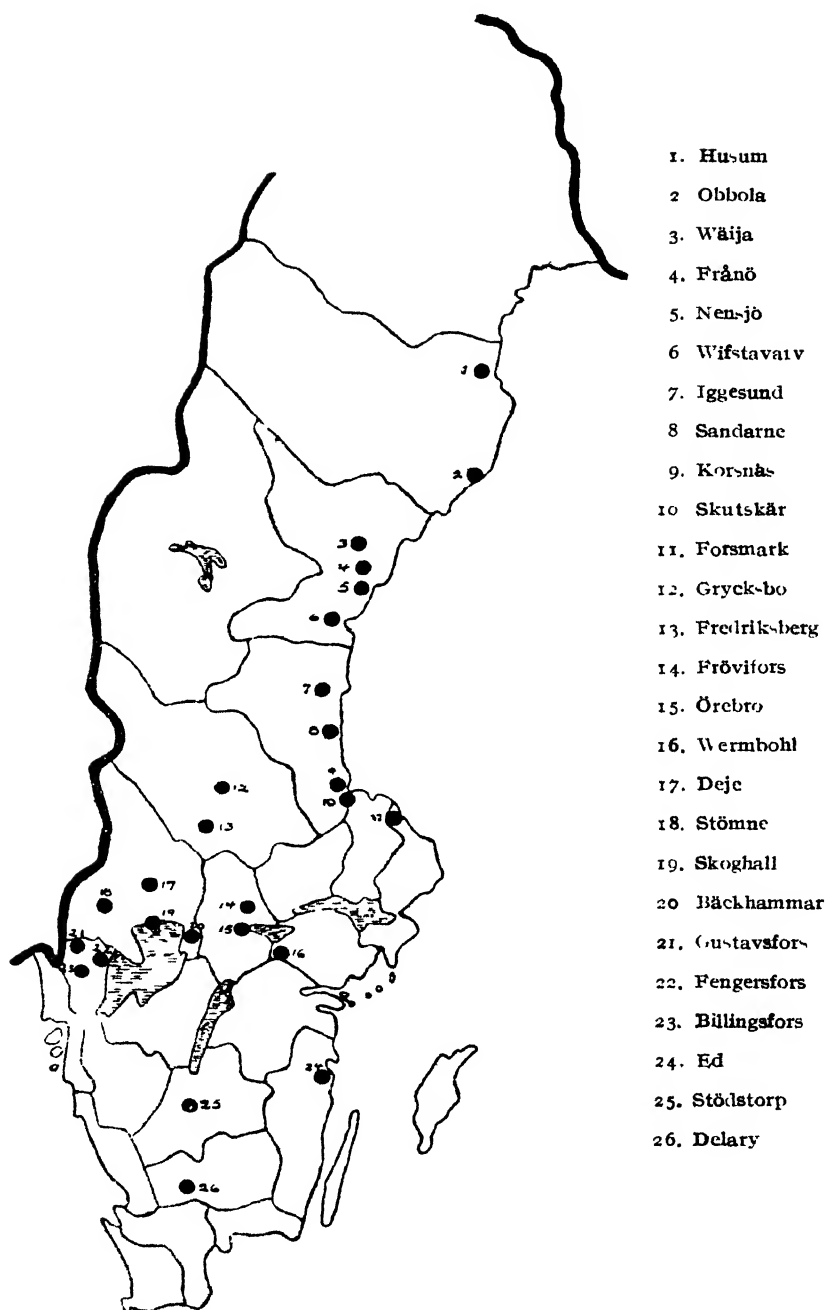


FIG. 17. — Swedish Sulphate Cellulose Factories.

waste calcium were: calcium thiosulphate 0.076 %; sulphur, as sulphite 0.005-0.10 %. The remainder (7.52-21.26 %) consisted of silicates having no action upon plants, clay, sand etc.

In the waste lime left in heaps for a long time, the water content varied from 18 to 42 %, the weight per litre being from 1 to 1.5 kg.

4) Judging from its chemical composition, lime waste is quite innocuous.

5) The cultivation experiments made with barley and mustard, entirely confirm this statement. Both in small, and in large applications, the waste lime proved equivalent to slaked lime, and hence can be advantageously applied to soil that requires lime and which is in the vicinity of the factory.

Owing to its unsatisfactory physical consistency, it is better to keep the lime waste in small heaps and to allow it to freeze during the winter, otherwise it can be treated similarly to peat used for litter, viz. thrown while still damp into moulds, the solid bricks thus obtained being passed through a mill, a cylindrical crusher, or some similar machine, in order to break them up into pieces suitable for spreading over the field.

11. The Effects of Acid and of Alkaline Fertilisers (6 years, practical work in the experiment fields at Spitsbergen, Netherlands. (De invloed van Zure en alcalisch bemesting op den groei der gewassen, 6 jaren practyk op het proefveld te Spitsbergen).

HUDIG, J. and MEYER C., in *Verslagen van landbouwkundiges onderzoekingen der Rijkslandbouw proefstations*, No XXVI, pp 60-86, fig 1, graphs 4. 's Gravenhage, 1922

Manurial experiments have been made by the authors for 6 years at the experimental station at Groningen (Netherlands) with the special object of studying the effect of acid and of alkaline fertilisers.

The substances applied were: superphosphate and ammonium sulphate, basic slag, Chile nitrate and carbonate of lime. The plants used included barley, oats, potatoes and peas, as well as barley with clover and serradella (*Ornithopus sativus*). The authors learnt from experience that an acid fertiliser should never be used for a soil that is already acid; in such a case, ammonium sulphate must never be applied. Chile nitrate may give good results, provided the soil is not too acid.

By adding a sufficient amount of carbonate of lime, the fertility of an acid soil can be improved, but the good effect will be neutralised if the use of an acid fertiliser is continued, because such a fertiliser not only acts upon the plants for which it was intended, but also on the subsequent crop. An acid soil, in which the authors had planted potatoes, produced a small crop of poor quality owing to its need of lime, even after a dressing with Chile nitrate. Acid soils must be neutralised with carbonate of lime before potatoes can be grown.

A problem presenting a good deal of difficulty is to determine practically the *amount* of lime to be added to neutralise soil. The authors are of opinion that it is necessary to estimate the acidity of the soil in the

laboratory and for this purpose they devised a "conventional" method, because soil acidity which generally depends upon the humic substances present, is subject to considerable variation in the course of the year, and is a very indefinite property. The best indicator for this reaction is the plant itself. The authors made a series of experiments with given mixtures of soil and calcium carbonate. The results obtained agree very well with those given by titration in the laboratory.

The authors are convinced that the acid, or alkaline reaction of soil would not in itself be sufficient to cause disease in cereals. The alkaline reaction appears to be connected with the influence of bacteria. The fact that leguminosae grow badly on acid soil and better on alkaline soil, is probably to be attributed to the life conditions of the root bacteria.

The optimum is evidently not the same for all plants and must be ascertained for each given species.

It is not known why an acid fertiliser is so injurious when applied to an acid soil, especially as the experiments made show the acid reaction not to be the cause of disease. In practice however this phenomenon must be taken into account.

The danger of neutralising soil with carbonate of lime is shown in the case of potatoes by the crop being attacked by *Actinomyces scabies*. This disease never occurs in soil where the acidity is above pH 5.16.

In order to ascertain the best soil condition, two cases generally must be distinguished: 1) when a leguminous crop is not desired, 2) when a leguminous crop is to be grown. In the first case, the acidity of the soil should be kept low. If it is too high, lime must be added till the required degree of acidity is attained. If the soil contains an excess of lime, acid fertilisers should be added till alkali is sufficiently neutralised.

Cereals should be given an alkaline fertiliser in the form of basic slag, or Chile nitrate.

Beetroots should be treated in the same way.

Potatoes ought to have an acid fertiliser — e. g. superphosphate and ammonium sulphate.

In the second case, a slightly alkaline reaction should be maintained.

Cereals should be given an acid fertiliser.

Beetroots an alkaline fertiliser.

Potatoes an acid fertiliser.

Leguminosae a phosphatic fertiliser, preferably in the form of basic slag.

In both cases, potassic salts can be used.

The following are the final conclusions reached by the authors after their 6 years work:

1) Except in rare cases, acid fertilisers should never be used for acid soils;

2) Leguminosae require a neutral or slightly alkaline soil and grow badly on acid soils.

3) Potatoes need a slightly acid soil.

4) It is possible to determine in the laboratory whether a soil needs lime and the amount necessary to neutralise it.

D. V. S.

12. Investigations on the Assimilability of Phosphoric Acid in Basic Slag and certain other Phosphates by means of Sand Cultures.

MASCHAUPT, I. J. G. (Onderzoek naar de opneembaarheid van ext in Thomas fosphaat en enkele andere fosphaten aanwezige phosphorzuur door middel van zandcultures) in *Verslagen van Landbouwkundige onderzoekingen der Rykslandbouwproefstatens*, No. XXVII, pp. 82-113. Gravenhage, 1922.

The author has made a special study of the question of solubility of phosphates in the soil before assimilation by roots of plants, in order to resolve the problem from the practical standpoint.

Experiments were made as to the solubility of various phosphates in water containing carbonic acid, and also the rate of solubility under similar circumstances, when the extraction is continued indefinitely. This enables the investigator to obtain a clear idea of the actual process existing in the soil. The solubility of the phosphates in water containing carbonic acid is comparable with the solubility in the standard 2 % citric acid solution.

The author has made a series of culture tests. Oats were sown in sand cultures in glass cylinders. To each was added 6.25 kg of pure sand and 1 litre of water containing :

4.4325 gm. Sodium nitrate (NaNO_3)
 1.0850 gm Potassium chloride (KCl)
 0.7675 gm Magnesium sulphate (Mg SO_4 7 aq)
 0.1875 gm. Manganese sulphate (Mn SO_4 4 aq)
 0.078 gm Ferrous chloride (Fe Cl_2 6 aq)

Three and a half months later chemical analyses were made to ascertain the quantity of phosphoric acid assimilated by the plants. The phosphates used were, basic slag, Algerian and Florida mineral phosphates, bone meal and pure tricalcic phosphate.

The results are summarised as follows : The nutritive value of a phosphate is determined in the first place by the solubility of the phosphoric acid. Plants no doubt have therefore certain requirements as regards the concentration of phosphoric acid in soil water.

Determinations of solubility such as are in general use in agricultural chemistry are therefore justified in principle as they are made to ascertain the practical value of the phosphates.

As regards the methods by which to determine solubility, the WAGNER 2 % citric acid method demonstrates the lower value of basic slag in this respect when compared with some other phosphates. This method is, however, insufficient when applied to other phosphates as too great a value is attributed to tricalcic phosphate and bone meal.

In classifying the phosphates according to the yields obtained thereby, the following list is given in order of value :

Basic slag, pure tricalcic phosphate, bone meal, Florida phosphate, Algerian phosphate.

Classified according to solubility in water containing carbonic acid, the same order of sequence is given, with the exception of Florida phosphate which is inferior to Algerian phosphate.

Classified according to percentage of phosphoric acid, contained in the phosphates and absorbed by the plants, the same order still holds good.

The author draws attention to the fact that the figures recorded in these trials to determine the value of phosphatic manures refer only to oats, and subject to the special conditions maintained during the experiment. The alkaline reaction on the culture solution due to the presence of nitrate of soda should for example have a marked effect.

It would be interesting to repeat the tests with the same phosphates but with other plants, and with the addition of other nitrogenous salts, e. g. ammonium nitrate, sulphate of ammonia, calcium nitrate, etc.

D. V. S.

13. Analysis of Samples of Basic Slag.

VAN KRUYSS. M. J. (Onderzoek en bemonstering van Thomasphosphaatmeel) in *Verslagen van landbouwkundige onderzoekingen der Rijkslandbouwproefstations*, No. XXVI, pp. 96-105. Gravenhage, 1922.

The basic slag used in the Netherlands has always received a ready sale elsewhere. For this reason it is important that there should be as near an agreement as possible between the analyses made in other countries. The standard methods in use to determine the phosphoric acid content in Belgium, Germany, and Switzerland are as follows: 1) Molybdate; 2) Citrate; 3) von Lorenz; 4) Uranium, 5) Grete.

The author has compared the analyses made in these countries with those made at the Fertiliser Control Station in the Netherlands, and they are in complete accord. If on the other hand, differences are reported, these should not be attributed to experimental error; for instance the samples may be very small, or they may not be homogeneous as they may contain large quantities of steel particles which during transport may have separated into portions of different degrees of fineness, or the sample may have been taken without taking the necessary precautions.

D. V. S.

14 Composition of Stassfurt and Alsace Potash Salts.

VÜRTHEIM, A. (Over desamestelling van Stassfurter en Elzasser kalizonen) in *Verslagen van landbouwkundige onderzoekingen der Rijkslandbouwproefstations*, No. XXVI, pp. 1-8. s'Gravenhage, 1922.

The author has made thorough analyses of a series of samples of potash salts of French and Germany origin. He states that the German salts generally consist of a mixture of natural and artificial salts and a certain percentage of sulphates and chlorides of calcium and magnesium of the "hartralz" and "carnallite" type. The kainits contain as much as 12.4 % potash. Other salts contain 20 % and 40 % potash. The potash content of the latter has been raised by the addition of artificial potassium chloride or has been purified by crystallisation.

The 20 % Alsation salts never contain magnesium sulphate; the composition is much less varied than in the case of German salts. The chief

constituent is fairly pure sylvinit, combined with a small quantity of anhydrite and argillaceous material.

From the point of view of fertilising value these salts are equivalent to the 20 % German salts. D. V. S.

15. The Comparative Values of Nitrogenous Fertilisers.

HOFFMANN, T. and ROLLE, O. Düngungs-Versuche mit Stickstoffdüngernt *Mitteilungen der Deutschen Landwirtschafts-Gesellschaft*, Year XXXVII, Par. 36. Berlin, 1922.

The *Deutsche Landwirtschaftliche Gesellschaft* has been appointed to study the question of the application of nitrogenous fertilisers in German agriculture, therefore the second Station of that Society has carried out 68 experiments with nitrogenous fertilisers and only 57 with other fertilisers.

The experiments were made in the open and under as natural conditions as possible. When necessary, they were entrusted to the landowners and the results were tested by the station staff, if the place was easily accessible, otherwise the services of school-masters, or employees, in the chemical industries (aniline, or soda) etc. were obtained. As a rule the area of each experiment plot was one acre.

The fertilisers used in the experiments were: sodium nitrate, ammonium sulphate, ammonium chloride, double sulphate of ammonium and potassium, ammonium nitro-sulphate. Rye was usually grown, and more rarely wheat and oats; potatoes were cultivated in one case. The increase in production was always considerable and greater in proportion when moderate, rather than large, quantities of fertiliser were applied. There was no appreciable difference in the effect of the various kinds of fertiliser employed.

Although the net return (the result of subtracting the price of the fertiliser from the value of the crop) was not taken into account, the benefit derived by the various soils from the use of nitrogenous fertilisers and their need of such fertilisers, were clearly brought out.

The following will serve as an example: rye grown after oats on sandy soil, gave under different conditions the following returns:

	Straw quintals	Grain quintals
a) Control: 5 quintals kainit, 4 quintals basic slag	18.6	26.0
b) <i>Id.</i> + 32 kg. nitrogen as sodium nitrate	32.2	50.3
c) <i>Id.</i> + 32 kg. nitrogen as ammonium nitrosulphate	29.9	43.1
d) <i>Id.</i> + 32 kg. nitrogen as ammonium chloride	29.8	45.0

L. V. '

16. Chemical Manures in Poland.

STÉPHANE KROIKOWSKI *L'état de l'agriculture en Pologne et les perspectives des récoltes pour l'année courante. L'Est Européen, Year III, No 11-12, pp 342-343.*

Agriculture in Poland, as can be seen, has made great steps towards complete recovery, and it will not be long before it will have regained its former prosperity. Progress has been much more rapid than had been anticipated in professional circles. Among the many problems of the moment which need solving, there are two of primary importance that, in the immediate future may impede the advance of agriculture, and these are, the provision of artificial fertilisers and of capital for rural development.

One of the first obligations of the Government and of the agricultural and commercial organisations is to supply farmers with artificial manures. No solution has yet been found to this problem although attempts were made on two occasions to effect a solution by the passing of legislative measures. There are at present no restrictions as regards the importation of artificial manures. However, private enterprise has been able to supply this shortage to a small extent, but it is not possible to surmount the chief obstacle, which consists in the disproportion between the cost of manure and the market price of wheat, the sale alone of which will allow farmers to obtain manure together with the disproportion between the state of affairs in Poland and those abroad. The farmer in Poland has paid this year for the fertilisers necessary for his spring sowings, 120 kg of wheat for 100 kg of 40 % polish salt, although the farmer in Czechoslovakia for the same quantity has given only 46 kg, and the German no more than 13 kg. In Poland he has had to pay for 100 kg. of superphosphate 76 kg of rye, in Czechoslovakia 46 kg, and in Germany 20 kg; 100 kg of nitrate of soda have cost 225 kg. of rye in Poland, 98 kg in Czechoslovakia and 40 kg in Germany. The Government and the Assembly, wishing to assist Polish agriculture in the provision of chemical manure, granted State financial guarantees to the agricultural and financial organisations for the making of contracts with the principal foreign countries for the importation of artificial manures and other goods essential for the increase of crop production.

Up to the present time, three such guarantees have been allowed. The first, by a decision of the Ministerial Economic Commission on December 23, 1919, for a sum of 2 050 000 pounds sterling; the second, in pursuance of the measure passed by the Assembly, February 4th, 1921, for 2 000 000, and the third, by the measure of January 24th, 1922, for a similar amount. On the basis of these guarantees the agricultural and commercial organisations importing manure and agricultural requirements, have obtained the right to export wheat and other farm products to foreign countries in sufficient quantity so as to realise enough by their sale to meet the cost of the goods imported. On account of certain reservations imposed with regard to the supply of home necessities and also

owing to difficulties arising from the compensative nature of the transactions, the guarantees under this provision could not be allotted exclusively to the importation of artificial manures, and the amount has been insufficient to meet the requirements of agriculture. In consequence, the use of artificial manures has had to be very greatly curtailed, as compared with the amount used before the war, which was as follows :

In former Prussian Poland	78 211	10 ton wagons
» the Congressional Kingdom.	26 700	» » »
» Little Poland	14 300	» » »
	—	
Total . . .	119 211	» » »

of which :

Superphosphate, about	30 000	wagons
Basic slag about	52 000	»
	—	62 000 wagons
Kainite about	24 000	wagons
Potash salts about	24 000	»
	—	48 000 »
Nitrate of soda about	7 300	wagons
Sulphate of ammonia about	1 200	»
Nitrate of lime about.	500	»
	—	9 000 »
	—	
Total . . .	119 000	wagons.

Amount of chemical manures used in each district : Former Prussian Poland :

Potash manures	41 411	wagons
Nitrogenous »	5 300	»
Phosphatic »	31 500	»
	—	78 211 wagons

Former Congressional Kingdom:

Potash manures	5 200	wagons
Nitrogenous »	2 800	»
Phosphatic »	18 700	»
	—	26 700 »
Potash manures	1 400	wagons
Nitrogenous »	900	»
Phosphatic »	12 000	»
	—	14 300 »
	—	
Total . . .	119 211	wagons.

In Former Prussian Poland farmers applied about 200 kg. of chemical manures per hectare of arable land, 42 kg. in the Kingdom and nearly 25 kg. in Little Poland. For the purpose of comparison, it may be mentioned that, before the war, Germany used 76 kg. per hectare.

Before the war the output of the country amounted to 25 000 wagons of superphosphate, the product of 11 factories, and 2 000 wagons of potash salts — the yield in 1911 — from Kalusz mines.

During the war practically no artificial manure was used ; in 1919, 950 wagon-loads were applied, 3 660 in 1920, 9 900 in 1921 and 4 700 up to the month of June 1922. In 1919 Kalusz supplied 653 loads, 1490 in 1920, 2400 in 1921 and the mines will probably yield 5000 in 1922.

Imports of artificial manures :

1920	3 525 wagons
1921	5 259 " "

The incorporation of Upper Silesia will increase very considerably the potential output of Polish artificial manures. There are actually at the present time the following large manufacturies : Scharff at Zawada, with an annual output of 10 000 wagons of superphosphate : Ceres, 6000 wagons ; upper furnaces Friedrichshütte, 3 000 wagons of basic slag ; Charkow, from 12 000 to 15 000 wagons of nitrate of lime, and some gas works with an output of about 3 000 wagons of sulphate of ammonia. As very little nitrate of lime is used in the country, the factory at Charkow will take up the manufacture of sulphate of ammonia.

In the district belonging to the free town of Danzig there are three superphosphate factories, with a production of 9 000 wagons, but these factories cannot be included on account of an enactment with Danzig which allows that town to export its products to foreign countries.

D. v. S.

Agricultural Botany.

17. Inventory of Seeds and Plants imported by the Office of Foreign Seed and Plant Introduction, United States Department of Agriculture (1) during the Period from

I. — *October 1 to December 31, 1917*, No 53, pp. 86, figs 5 Washington, 1922.

II. — *January 1 to March 31, 1918*, No 54, pp. 56, figs. 4. Washington, 1922.

III. — *April 1 to June 30, 1918*, No. 55, pp. 48, figs. 2. Washington, 1922.

IV. — *July 1 to September 30, 1918*, No. 56, pp 34, figs. 6. Washington, 1922.

V. — *October 1 to December 31, 1918*, No. 57, pp. 54, figs. 4. Washington, 1922.

From October 1 to December 31, 1917, 1729 new plants were introduced into the United States. The following have been selected as of special interest :—

CEREALS. — "Yeoman" wheat (hybrid obtained by Prof. BIFFEN

(1) See R. 1922, No 1031. (Ed.)

at Cambridge) ; this has given a yield of 64 qx. per hectare in a preliminary Trial in the United States.

" Federation " (hybrid obtained by FARRAR in Australia), has since given very satisfactory results on the Pacific coast of north America.

Collection of wheats coming from South-West Africa :

" Huanhtli " from Mexico (*Amaranthus paniculatus*), cultivated by the Aztecs before the discovery of America ; the seeds were ground, and cooked and made into cakes ; it occupied an important position in the market, was used to pay the tribute, and it was employed also in religious observances etc. This plant succeeds well also in arid regions where it is impossible to grow maize.

LEGUMES. — Collection of beans, peas, lentils, etc., introduced from Guayaquil (Ecuador), Caracas (Venezuela), Rosario (Argentina), Para (Brasil), Punta Arenas (Chile), total about 63 types which will serve as a basis for hybridisation and selection purposes.

FORAGE PLANTS. — Collection of forage leguminous plants, including : —

Cassia palellaria, *C. pumila*, *Crotalaria elata*, *C. usaramoensis*, *Indigofera sumatrana*, *I. suffruticosa*.

Wild rice from West Africa, rhizomous ; in natural surroundings constitutes one of the best forage plants named by CHEVALIER, *Oryza barthii* (1).

Eragrostis superba of Johannesburg, South Africa.

Seed of Napier or Elephant Grass (*Pennisetum purpureum*) from Rhodesia, where it is drought resistant.

A species of spineless prickley pear, without seeds, selected by B. HARRISON at Burringbar.

PLANTS USEFUL AS GREEN MANURE AND FOR BINDING THE SOIL. — The list of leguminous plants in the collection introduced from Buitenzorg are cultivated there for green manure purposes.

Schrankia leptocarpa. — Mimosa, wild, rare, from Bahia (Brazil). Small bush form with small spines, useful as cud.

Swainsonia sp., from Queensland (Australia) should prove a valuable fodder crop in semi-tropical areas.

Acacia cyclops, valuable as a sand binder.

STARCH CROPS. — *Canna edulis*, from Australia where the bulbs are used to prepare arrowroot ; cultivated successfully in Florida (Everglades), a single plant having produced 80 lb. of tubers.

Promising variety of " Yam " (*Dioscorea alata*) from Honolulu (Hawai).

" Malango coloré " from Porto Rico, variety of " yantia " (*Xanthosoma* sp.); edible yellow fleshed corms ; not affected by flooding and recovering quickly from light, spring frosts. This plant has already been grown with success in southern Florida.

OILS, MEDICINAL, STIMULANT PLANTS ETC. — *Sesamum angolense*, may possibly be used to advantage in the improvement of the common

(1) See R 1911, No. 802 ; R 1914, No. 998. (Ed.)

sesame, which has the defect of scattering its seeds, thus rendering mechanical harvesting impossible.

Five species (three still undetermined one *Sesban* sp. and one *Caryocar* sp.) utilised in British Guiana for stupifying fish; these may contain valuable new alkaloids.

"Guarana" (*Paullinia cupana*) from Para, where the seeds which contain 5 % of alkaloids, are used to make a beverage.

Artemisia cina from Turkestan, yields the vermifuge known as "wormseed."

Eucommia ulmoides (1) from China (the "tu chung shu" and "she mien shu" (floss silk tree).

MARKET CROPS. — *Chenopodium nuttalliae*; "Huahtzontli" from Mexico; *Deringa* (= *Cryptotaenia*) *canadensis*, the "mitsuba" from Japan. Where it is a popular vegetable; occurs also from Nova Scotia, to Texas but has never been cultivated or used as a vegetable in America. Two varieties of *Hibiscus subdariffa*, "or roselle", used for jellies.

Astragalus sinicus. "Genge clover" or "Chinese clover" from Japan; an extra high price is paid for tender shoots in the Chinese market, sometimes six times as much as for any other vegetable; this plant, in appearance similar to clover, is popular owing to the fact that the young shoots can be eaten fresh

Cucumis melo, "Casaba" from Australia, probably a native of India; eaten fresh or cooked.

Solanum mammosum, "susumber", from Porto Rico, possibly a useful stock for grafting egg-plants.

Solanum quitoense, from Columbia, with edible fruits the size of small oranges, used for flavouring preserves, sweets etc. and as a beverage with milk and sugar.

Jatropha urens, "Chaya" from Yucatan a bush with succulent leaves which are cooked like spinach; this plant may solve the difficulty of finding a suitable vegetable for tropical countries or where irrigation is impracticable.

Trichosanthes quinquangulata from the Philippines; a Cucurbitacea with fruits somewhat larger than an apple, very attractive; fruits keep indefinitely.

ORNAMENTAL GARDEN PLANTS. — *Pogonopus speciosus*; from Guatemala, shrub with scarlet bracts, suggestive of poinsettia.

Sobralia macranthia from Guatemala a terrestrial orchid which grows to a height of 4 ft. and has a large showy flower.

Dahlia popenovii Safford, new species from Guatemala, and in all probability the ancestor of the cultivated *Cactus dahlia*.

Prunus serrulata var. *sachalinensis*, from Japan ("pink flowered wild forest cherry"); supplies excellent cherry wood.

Hydrangea paniculata praecox from Hokkaido; grows to a height of from 20 to 30 ft.

(1) Cultivation in Italy has been advised. See R. 1921, No 829. (Ed)

Lycoris aurea from China (Hupeh Prov.) with large ochre-yellow flowers and *L. radiata* with carmine red flowers.

Amygdalus Triloba, from Jamaica, large flowering almond, one of the most beautiful flowering shrubs.

Rosa helenae from China (Hupeh) where it forms thickets about 6 metres across and 6 metres high, covered with masses of fragrant white blooms.

Lilium giganteum, *L. nepalense*, *Prunus cerasoides* (red flowers and acid fruits), *Pr. napaulensis*, *Pyrularia edulis* etc. from India.

Pomaderris elliptica (shrub with mass of yellow flowers) from New Zealand.

Casuarina sumatrana from Sumatra, may prove a useful avenue tree.

Cymbopetalum penduliflorum from Mexico; the fragrant flowers were dried and used in flavouring cocoa and other foods by the ancient Mexicans.

Cereus sp. from Columbia with blood-red flowers, etc.

VINES. — From San Cristobal (Vera Parz, Guatemala); wild vines with large racemes, 2-3 inches long, closely packed, with stones 2 cm. diameter, acid juice, wild tropical varieties with large grapes, very promising for selection purposes.

Vitis tiliacifolia Humb and Bonpl. (= *V. caribaea* D. C.) from Zacuapaw, Mexico, a wild grape, and *V. tiliacifolia* from Mogone (Oaxaca, Mexico), a species probably belonging to the Muscat group. All these species adapt themselves to the development of a really choice grape for tropical regions.

TREES AND FRUITS. — Of the greatest importance. In the Ichang region of China, a selection of varieties resembling both tangerines and pumpkin: a lemon (*Citrus ichangensis*), very fragrant, excellent for refresh-drinks, is able to withstand colder temperatures than other citrus fruit trees (as low as -7° C).

Claucenia lansuim ("Wampi") from Canton, large fruit, popular in the United States and in China.

The king orange, Vermillion orange or chu-kaa, variety of *Citrus nobilis* from China, popular fruit resistant to citrus canker.

Various *Pyrus* spp. from China, hybridised and selected, is likely to give a species resistant to blight and to apple and pear necrosis (*Bacillus amylovorus* [Burrill] Trev.); other types more resistant to cold and which may in consequence be adapted to more northerly regions:

Pyrus calleryana from Hupeh (China) and from central Korea (the northern limit of this species);

P. betulaefolia \times *P. phaeocarpa*, from the Extreme North of China as far as the Yangtse River and is utilised as a stock.

P. serrulata, *P. ussuriensis*, the most popular types of Chinese pear.

After many years breeding and selection, Dr. VAN FLEET has produced some remarkable varieties of chestnut (Arnold Arboretum, Jamaica Plain, Mass.) and by crossing *Castanea pumila* "chingapin" with the Chinese species *C. mollissima*, the American chestnut (*C. dentata*) and the Japanese species (*C. crenata*). The selection of the Chinese species are very re-

sistant to "bark disease" (*Endothia parasitica*) and can be safely recommended for orchards. They are not large forest trees.

The future of the other Chinese species (*C. henryi*) which grows to a height of 75 to 100 ft. on the upper Yangtze River as far west as Mount Omei is uncertain as it depends on its resistance to bark disease.

C. seguinii "chinquapin", a shrub from the mountain slopes in Central China, immune to bark disease and more adapted to moist localities.

Cydonia oblonga, Russian variety of quince which at Murdock (Kansas), has proved hardy, bears excellent fruit, whereas the standard varieties do not fruit there.

Semi-tropical and tropical fruits, from Guatemala: — *Persea schledana*, "coyo"; six promising varieties of avocado (*P. gratissima* [= *P. americana*]); *Malpighia* sp. "azerola", larger fruit than *Medulsa*; *Annona diversifolia*, adapted to the coastal plains where the "cherimoya" (*A. cherimotha*) does not succeed; *Inga* sp.; *Juglans mollis*, tropical walnut which forms only a small tree but fruits abundantly; *Passiflora ligularis* "grandilla" etc.

From Mexico: a new Annonaceae (*Sapranthus* sp.); a variety of White sapote (*Casimiroa edulis*), fruit pyriform, yellow, delicious flavour.

From Paraguay: *Butoa sellowiana* "nyandu-aphisa".

From Nice (France): *Alectryon subcinerum* (= *Nephelium leiocarpum*), probably adaptable as a stock for *Litchii chinensis* cultivation trials are being made in Florida; *Lausonia inermis* "henner".

From Ponta Delgada (Azores), *Persea azorica* which forms part of the collection made of this species.

From North Africa. Dr. TRABUT's hybrid between the Abyssinian or Erythrean fig *Ficus palmata* and the common fig (*F. carica*).

Zizyphus mauritiana from Mauritius and *Z. mistol* from Argentina has increased the collection of the large fruiting jujubes (the introduction of numerous varieties from China).

Telfairia pedata, Koumé, from East Africa, rank-growing tropical liana which covers the trees at the edge of the forests of East Africa; produces fruits 2 ft. long, and 8 inches in diameter, bearing over 250 large flat, oily seeds the size of an almond and of good flavour (1).

Artocarpus odoratissima, delicious flavour, has proved hardy in Southern Florida but its fruits are of little value.

From Malakka, *Mangifera longipes*, may have value for stock purposes, has proved promising in California but nothing definite yet established.

(1) For cultivation in Zanzibar, see R 1915, No 1. Analysis of seeds (%): — water 65.4 — ash 2.04 — fats 36.02 — protein 19.63, — fibre 7.30 — non-nitrogenous extract, 28.45 (SADERCK Die Kulturgewächse der Deutsche Kolonien und ihre Erzeugnisse. Jena, 1899, p. 245)

Analysis made by the Imperial Institute, London: approximately 11 % fibrous material, 38 % husk and 51 % seed. This gives 56.9 % light reddish-brown oil, non-drying; specific gravity 0.919; acid value 2.6; saponification value, 196.00; iodine value 89.00. *Foreign Seeds and Plant Introduction, Plant Immigrants* No 196, Aug 1922 (Ed.)

From China (Canton), *Myrica rubra* "yang mei", young trees in California and although a very slow grower, produces fine fruits.

Amongst the small fruits have been selected:

From Guatemala, *Crataegus stipulosa*, fruits used for jellies. This with the Chinese variety, *C. pinnatifida* provides material for the breeding of new types of hawthorns which should be suitable for a wide range of conditions.

From China, *Ribes fasciculatum chinense*; *Actinidia chinensis* "yang tao"; another form of this species introduced from the Southern Atlantic littoral, at Pugot Sound and has produced only a comparatively small quantity of fruit, but of excellent flavour and good transport quality.

From Madagascar: *Aphloia theaeformis*, low tree on mountain slopes, leaves said to possess medicinal value, small white berries.

From South Africa, *Carlissa carandas*, "amatungulu", introduced into the Philippines and said to be one of the best small fruits; *C. grandiflora* introduced from Natal into the United States in 1902, and has become a popular hedge plant; perhaps the hybrids of these species can be made.

FOREST PLANTS. — *Tamarix aphylla* "athel" an African Tamarisk, one of the most successful introductions of recent years into the south-west of the United States, considered by TRABUT as one of the best species, both for timber and as a windbreak. In the Coachella Valley, its handsome form is already transforming the landscape by the addition of great rows of beautifully shaped trees to the desert. Whether it would be advisable to introduce the gall insect to which TRABUT calls attention and which produces on this tamarisk large quantities of galls containing 45 % of tannin, is a question requiring careful study.

Several large-fruited Mexican oaks (*Quercus* sp.), adaptable probably like *Lithocarpus cornea* from Hongkong to the climate conditions along the Gulfcoast.

From New Zealand, *Dammari australis* "Kauri pine", stateliest of all the giant forest trees because of its perfectly columnar trunk, a safeguard against extinction in its native country: *Dacrydium cupressinum* the "rimu" a most striking conifer resembling the drooping yew, *Antela arborescens*, "New Zealand Cork-wood" giving a timber weighing little more than half that of cork and which consequently may be useful in the cold storage industry, etc.

From New South Wales, *Casuarina cunninghamiana*, hardier than the *C. equisetifolia*, planted by thousands in Southern Florida; tough timber, and foliage used for feeding stock. *Azadirachta indica* "neem tree" of India, wood resembles mahogany, fruits contain a medicinal oil and the sap is made into a cooling drink.

F. D.

18. Useful *Rubus* spp. in Cuba.

BRUNER, S. C. Una nueva planta hortícola hallada en el Pico Turquino. *Revista de Agricultura, Comercio y Trabajo*, Year V, No. 5, pp. 27-28. Habana (Cuba), 1922.

On the Turquino Peak (Cuba) at a height of some 2000 m. the author found and collected for the "Estación agronómica", Santiago de las Vegas a species of *Rubus*, apparently hitherto unknown which grew to a height of 1.20 to 1.80 metres and had red and black drupes containing a pleasant acid juice. This species might perhaps be used for crossing with *R. rosae folius*, also found by the author on the same mountain and examined at the Estación agronómica. The latter has a red fruit, similar to that of the raspberry, but not acid. As the other new *Rubus* sp. is noted for its acid taste, it is very probable that the hybrid would possess the medium acidity and would form a popular fruit, which is much wanted in Cuba. F. D.

19 Chemical Analyses of Cultivated and Wild Forage Crops in Argentina.

I. PAULSEN, F. F. La alfalfa común y la alfalfa de Perú cultivada en el país Su estudio químico-agrícola comparativo *Revista del Centro Estudiantes de Agronomía y Veterinaria*, Year XV, No. 106, pp. 16-25 Buenos Ayres, 1922

II REICHERT, F. and TRELLES, R. Sobre la composición química de plantas forrajeras cultivadas e indígenas del país *Ibid.*, No. 107, algunas pp. 30-32 Buenos Ayres, 1922

I — The Facultad de Agronomía y Veterinaria, at the University of Buenos Ayres has undertaken the study of the chemical composition of cultivated and wild forage plants in Argentina

Composition of hay (air-dried forage)

Local name	Latin name	Moisture	Ash	Cellulose	Protein	Fats	Non-nitrogenous extract
Sorgo Sudán	<i>Sorghum sudanensis</i>	10.60	6.05	27.00	15.30	1.75	39.30
Grama elefantes	<i>Pennisetum purpureum</i>	10.80	12.50	22.20	12.50	2.05	37.95
Yaragua	<i>Andropogon?</i>	8.65	9.50	34.60	14.80	1.65	40.80
Grama Rhodes	<i>Chloris gayana</i>	14.50	9.40	27.00	7.85	1.65	39.60
Trébol blanco	<i>Trifolium repens</i>	19.16	7.72	15.20	15.31	1.60	41.07
Arvejilla	<i>Vicia?</i>	16.50	9.20	21.80	16.62	3.60	27.48
Arbadilla	<i>Elymus?</i>	17.80	4.50	26.00	10.45	2.70	31.95

It appears therefore that the *Sorghum sudanensis* possesses a high protein and cellulose content and consequently has a distinct nutritive value. *Pennisetum purpureum* and the yaragua (*Andropogon* sp.) have a medium protein value; the *Chloris gayana* has a protein value but inferior quality hay; the *Trifolium repens* grown in the Experimental plots at the University has given hay with the average composition.

the arveja (*Vicia* ?), which is found growing wild over a wide area in the Cordigliera North Patagonia, is reported to be an excellent forage, and the above analysis indicate the superior protein value compared with the other plants; the cebadella (*Elymus* ?), grows wild in the same area as the *Vicia* sp. and has proved its value as forage. The authors suggest the cultivation of the *Vicia* sp.

II. — The Agricultural Laboratory (Facultad de Agronomía y Veterinaria) has made comparative tests with native trefoil and Peru trefoil, grown from imported seed (1). At the flowering period (December) the native trefoil is about 1.1 to 1.30 metres high and well developed, the Peru trefoil is only 0.90 to 1.10 m. and consequently gives rather less hay.

The average of 217 analyses of the native trefoil made in the Chemical Laboratory at the Ministry of Agriculture, and the analyses of both native and Peru specimens by the authors, are given: %

ash 10.24, 9.02, 0.34; cellulose 31.64, 37.74, 29.97; carbohydrate, 36.37, 32.61, 36.57; fats 1.81, 1.63, 1.81; crude-protein, 18.54, 19.00, 22.51; pure protein 13.25, 15.75, 16.18; pentoses (authors' analyses) 16.12, 14.83. The Peru trefoil has somewhat less nutritive value: 1: 2.43 compared with 1: 3.10 (authors' analyses). 1: 3.04 (average of 217 analyses) for native trefoil; calorific value, 228.3 calories compared with 224.5 and 226.7 respectively; high amide value (310 compared with 306 and 309)

The value of the Peru trefoil has been ascertained after a two year test.

In Tucuman, very satisfactory results have been obtained with the Peru trefoil, but as regards unit production and the number of cuttings, the authors recommend extending the cultivation to other parts of the Argentina where the common trefoil has given good results (Río Negro, Mendoza, etc.).

F. D.

20 Cyanophoric Plants of the Makiling Region (Philippines).

HERBERT, D. A. *The Philippine Agriculturist*, Vol. XI, No. 1, pp. 11-16. Los Baños, Laguna, 1922

Two modifications of GUIGNARD's test were used: 1) the hanging of a strip of moistened sodium picrate paper in a tube containing the material; 2) immersion of the material in sodium picrate solution to which a little chloroform had been added. The following cyanophoric plants have been identified: *Amaranthus spinosus* (traces in the leaves); *Buchanania arborescens* (large proportion in the leaves), *Anona muricata* (in all parts; in fruits only a trace); *A. reticulata*, *Alocasia indica*, *A. sanderiana* (traces in tuber and petiole); *Colocasia zebrina* (all parts); *Artocarpus integrifolia* (bark and leaves a trace); *Spondias lutea* (bark and flower traces); *Ipomea batatas* (traces in stem, leaves, fruits and roots; in some cases absent altogether); *Cucurbita acutangula* (traces in all parts; negative in fruits); *C. maxima* (ditto, but negative in flowers and fruits); *Cynodon dactylon*

(1) See R. 1921, No. 207 (Ed.)

(in leaves, stems, roots and rhizomes); *Oryza sativa*, *Panicum maximum*, *P. crus-galli*, *Paspalum dilatatum*, *Saccharum officinarum*, *S. spontaneum*, *Zea mays* (traces in roots, stems and leaves); *Cinnamomum camphora* (faint trace in bark and leaves); *Cajanus indicus* (traces); *Cassia alata*, *Centrosema plumieri*, *Dolichos lablab* (in both white and pink forms); *Strychnos nux-vomica*, *Areca catechu*, *Carludovica palmata*, *Cocos nucifera* (strongly positive in stem and pericarps), *Oreodora regia*, *Phytelephas macrocarpa*, Piper betle (leaves), *Eriobotrya japonica* (traces in bark and leaf), *Coffea liberica* (leaf and bark), *Citrus aurantium*, *C. decumana*, *C. limonis*, *C. mitis*, and *C. nobilis* (traces in bark, leaf and fruit), *C. hystrix* and *C. trifoliata* (traces in leaf only).

In the majority of cases the greatest amount of hydrocyanic acid is in the bark but the distribution is not uniform in the same species; e. g. *Cucurbita cylindrica* and *C. pepo*, negative, *C. acutangula*, and *C. maxima*, positive. The variation in content when the same species is raised in different countries is evident in the case of *Grevillea robusta* which in Queensland (its country of origin), the results are positive and in the Philippines, negative (F. SMITH and C. T. WHITE, Interim Census of the Cyanophoric plants of Queensland. *Proceedings of the Royal Society of Queensland*, No. 27, pp. 89-91, 1920).

F D.

Plant Breeding.

21. The Law of Homologous Series in Variation.

VAILOV, N. I. (Director of Bureau of Applied Botany and Plant Breeding, Petrograd, Russia), in *Journal of Genetics*, Vol 12 No 1, pp 47-89, tables 2. London, April 1922.

The Linnean species which in the XIXth century were regarded as uniform, in the XXth century were separated by plant breeders and systematists into large numbers of "Jordanans" (small Jordan spp.) easily distinguishable both morphologically and physiologically.

Thus the number so far recognised does not include all existing species, but the data available shows an immense diversity and the complex nature of this study.

Investigations of Russian and Asiatic wheats (*Triticum vulgare*) have proved the existence of about 3000 small species, distinct both morphologically and physiologically.

For barley, 600 to 700 small species are known and for oats more than 600. A similar case is reported for rye, maize, Leguminosae, and Cucurbitaceae etc.

There is evidently need for systematic classification, and to construct the general generic schemes it is necessary to know the composition of Linnean species.

Before creating new varieties by crossing, it is essential to know what exists in nature. The diversity of material makes the matter extremely difficult and the construction of a simplified scheme of classification is essential.

In the present paper the author attempts to define the "law of homologous series of variation", with a view to differentiation, on comparatively simple lines.

In studying in detail the Linnean species, regularities in their diversity have been observed, in spite of their enormous polymorphism.

For example with cereals, there are 8 Linnean species of wheat, quite distinct as regards specific characters, and these form 3 genetical groups, as follows :

(I) *Triticum vulgare* Vill ; *T. compactum* Host ; *T. Spelta* L.

(II) *T. durum* Desf. ; *T. polonicum* L. ; *T. turgidum* L.

(III) *T. monococcum* L.

The 8 species *T. dicoccum* Schrank., occupy a position between the first and second group.

T. vulgare is represented by a multitude of Jordanons (varieties and races) which differ in the following characters :

1. Bearded, beardless, semi-bearded.
2. Ears white, red, grey, black.
3. Ears smooth, hairy.
4. Seeds white, red.
5. Winter, spring varieties etc.

These characteristics serve to differentiate between the series of varieties of the other 7 *Triticum* spp.

The same parallelism may be observed in the case of barley, oats, millet, cotton, *Agropyrum repens*, *A. cristatum*, *Brassica Napus*, *B. rapa* and of Cucurbitaceae.

As a result of these studies, the author states that it may be concluded that, in general, closely allied Linnean species are characterised by similar and parallel series of varieties ; and, as a rule, genetically related species have similar series of hereditary variation.

In the study of species of closely allied genera, the same regularity of polymorphism is noticeable ; for example the varietal composition of rye, *Triticum Secale*. Investigations made by V. P. ANTROPOVA and A. J. TOUPIKOVA at the Saratov Experimental Station, on samples of rye collected from different regions of European and Asiatic Russia, from Persia, Bokhara, Pamir and Afghanistan, showed a sharp polymorphism in rye no less than in wheat. The most interesting of these studies is that the characters which distinguish the different forms of rye appear to be strikingly similar to those marking the different forms of wheat. Both rye and wheat include the following characteristics :

- 1) Bearded, beardless and semi-bearded.
- 2) Hairy and smooth ears.
- 3) White (yellowish), red, and dark brown ears.
- 4) Violet ears and without anthocyanin.
- 5) Seeds green, white, red or brown.
- 6) Grains easily shed from glumes or vice versa ;
- 7) Hollow straw, or straw full of pith.
- 8) Fragile rachis, or strong rachis.
- 9) Long or short ears.

- 10) Dense or loose ears.
- 11) Hairy or smooth rachis.
- 12) Broad or narrow glumes.
- 13) Bearded or beardless glumes.
- 14) Many flowers on spikelets or only two flowers.
- 15) Rough or tender beards.
- 16) Starchy or flinty seeds.
- 17) Small or large seeds ;
- 18) Nerves highly developed on glumes or weakly developed.
- 19) Smooth leaf sheaths or hairy sheaths.
- 20) Ligula or no ligula.
- 21) Well-developed auriculae or none.
- 12) Smooth or hairy auriculae.
- 23) Violet or green seedlings.
- 14) Broad or narrow leaves.
- 25) Hairy or smooth leaves.
- 26) Thin or thick straw.
- 27) Short or long straw.
- 28) Procumbent or erect seedlings.
- 29) Early or late varieties.
- 30) Winter and spring varieties.
- 31) Resistant or susceptible to rust.
- 32) Simple or complicated branched ears.
- 33) Leaves with or without wax coating
- 34) Cross-fertilised or self-fertilised forms.

In general, the genus *secale* repeats in detail the series of variations of the genus *Triticum*, and the results are sufficiently complete to render it possible in many cases to presuppose certain forms hitherto unknown.

Thus for example in 1916 in Shugnan (Pamir) and in Afghanistan several varieties of *T. vulgare* were found the leaves of which were without ligula, hitherto unknown in botanical literature. *A priori*, basing an opinion on the principle of homologous variation, it was expected to find a form of rye without ligula, and in 1918 such a form was actually found among spring rye in Pamir.

The phenomena of homologous variation in both, from the phenotypical standpoints, is associated not only with genetically closely related Linnean species, but also with genera of a given family. The Jordanons Linnean species, genera, and the botanical families in the sense of JOHANNSEN may be termed phenotypical units. But no doubt the same rules apply also to genotypical variation. The majority of differences between varieties established by systematists are hereditary differences and although all the morphological and physiological systems of organisms are systems of phenotypes, they also imply genotypical differences. The existence in wheat of two kinds of beards, dominant and recessive, necessitates a search for the same division in other genera of *Gramineae*. In reality, two types of bearded oats were found, one dominant and another recessive, in crossing with the same variety two beardless forms : one recessive, the other dominant.

Conclusions :

1) Linnean species and genera more or less closely related to each other are characterised by similar series of variation with such a regularity that, once a succession of varieties in one genus or Linnean is known, it is possible to predict the existence of similar forms and similar genotypical differences in other genera and species. The similarity is all the more complete when there is a close alliance between Linnean species and genera.

2) Whole botanical families in general are characterised by a definite cycle (series) of variability which passes in a similar way through all genera of the same family.

The above conception may be represented by symbols in the following way : as already noted, different Linnean species and different genera are composed of an immense number of varying distinctions ; at the same time this variability is similar in nearly allied species and genera. These different varying characters are classed alphabetically, a, b, c, d , etc., and the different expressions are signified as $a_1 a_2 a_3$ etc, and $b_1 b_2 b_3$ etc.

For instance, let a indicate the colour of the glumes " and let a_1 = white, a_2 = yellow, a_3 = red, a_4 = grey and so on. The species and genera are not differentiated by these characters, which are repeated homologously throughout, but by specific complexes of a morphological and physiological nature, differences which may be called *radicals*. Radicals may exist for species, genera and whole families.

Thus for three nearly allied Linnean species of the same genus the following expression of their morphological and physiological peculiarities is given :

$$\begin{aligned} L_1 & (a + b + c + d + e + f + g + h + i + k \dots) \\ L_2 & (a + b + c + d + e + f + g + h + i + k \dots) \\ L_3 & (a + b + c + d + e + f + g + h + i + k \dots) \end{aligned}$$

L_1, L_2, L_3 , are radicals distinguishing these Linneans from one another, a, b, c, d are different varying characters, such as colour and shape of glumes, leaves, stems etc. Each of these characters is complicated and may be divided into two, three or more morphological and physiological units, a_1, a_2, a_3, a_4, a_5 etc. Each unit may be represented in terms of genotypical composition. Compared with the species *T. vulgare* L., *T. compactum* L. and *T. Spelta* L., it may be said that the radicals L_1 and L_2 are distinguishable simply by the density of the structure of the ears and stems, and L_3 by the density of spikelets, the grains enclosed tightly by glumes and extremely loose ears. The varying characters a, b, c, d , etc. are the same in all three species studied.

In the same way in the different genera, G_1, G_2, G_3, G_4 etc the composition of wheat (G_1) and rye (G_2) may be expressed by the formula :

$$\begin{aligned} G_1 & (a + b + c + d + e + f + g \dots) \\ G_2 & (a + b + c + d + e + f + g \dots) \end{aligned}$$

The contents bracketed are the same in both genera. The difference between their radicals (G_1) and (G_2) from a morphological standpoint, is limited to the character of the glume, the narrow shape of the seed of rye, and a few other characters of less importance.

A correct representation of a genus by formula would be as follows :

$$G_1 [(a + b + c + d + e + f + g + h + i + k \dots)] L_1, L_2, L_3, L_4, L_5]$$

The value of a systematic differentiation is evident therefore and will help greatly the study of varieties. Instead of searching for unknown forms, the investigation can definitely trace forms lacking system, by noticing similarities with the nearest known species and genera. In this respect a biologist places himself in the position of a chemist, who classifies substances according to their place in a system and creates them through synthesis.

Botany confines itself invariably to characters, colours, hairiness, beardedness, etc. ; chemistry on the contrary says little about the exterior of substances, but considers the chemical nature of compounds and their formulae. Numerous substances are thus reduced to a harmonious system of combinations of a few elements. The biologist in this respect is far behind, but genetics has learned during recent years to analyse organisms, and the synthesis of new forms. The regularities in polymorphism of plants established by a minute examination of variation in different genera and families can be compared to homologous series of organic chemistry e. g. carbohydrogen (CH_4 , C_2H_2 , C_4H_2). The series of compounds differing from each other are still characterised by many common properties in reactions ; every single hydrocarbon gives a series of compounds similar to that of other hydrocarbon.

In a similar way the genera (G_1 , G_2 , $G_3\dots$) and Linneans (L_1 , L_2 , $L_3\dots$) display their homologous series of varieties :

$$\begin{array}{ll} G_1 L_1 (a + b + c \dots) & G_2 L_1 (a + b + c \dots) \\ G_1 L_2 (a + b + c \dots) & G_2 L_2 (a + b + c \dots) \\ G_1 L_3 (a + b + c \dots) & G_2 L_3 (a + b + c \dots) \\ & L_1 a_1 L_1 a_2 L_2 a_3 \dots \\ & L_2 a_1 L_2 a_2 L_2 a_3 \dots \\ & L_3 a_1 L_3 a_2 L_3 a_3 \dots \end{array}$$

where a , a_1 , a_2 , a_3 are different characters distinguishing different varieties.

Further investigations will establish more precisely the law of homologous variation in plants and animals, and it may be possible to bring the same series into mathematical expression. The variation in form might be reduced to some geometrical scheme. G. A.

22. Determination of the Number of Chromosomes in the Genus *Avena*.

NIKOLAEWA, A., in *Zeitschrift für Induktive Abstammungs- und Vererbungs-Lehre*, Vol XXIX, Parts 3-4, pp. 209 and 210. Berlin, 1922.

Cytological researches on the roots of the oat have shown that the number of chromosomes varies in the different species. According to TRABUT'S scheme of classification, *Avena brevis*, *A. strigosa* and *A. nuda bivaristata* are clearly and wholly different from all the other species ; in fact, they possess 14-16 chromosomes, whereas *A. sterilis*, *A. Ludo-*

winana, *A. byzantina*, *A. fatua*, and *A. nuda (inermis)* have 42 to 48 chromosomes.

The author describes the results of a series of cytological investigations undertaken in order to ascertain the number of chromosomes in the different species of oats. This task was one of considerable difficulty owing to the length and the large number of the chromosomes. There are three groups :

1) with 44 chromosomes : *Avena sterilis*, *A. Ludowinana*, and *A. byzantina*.

2) with 48 chromosomes in the equatorial plate; *Avena fatua*, *A. sativa*, and *A. nuda inermis*.

3) with 14 chromosomes : *Avena brevis*, *A. strigosa biaristata*, *A. clauda*, and *A. pilosa*.

Avena barbata occupies an intermediate position with 32 chromosomes; its morphological characters are also intermediate.

The author recognized the difficulty in counting the chromosomes and thinks it would be better to distinguish only two clearly differentiated groups. The ease with which the species of the same group can be crossed may be explained by the cytological investigations which have shown that the nucleus is of almost identical construction in all these species.

When, on the other hand, it is desired to cross two species belonging to different groups, owing to the difference in the number of the chromosomes, any permanent union of these bodies during the maturation and fertilisation processes is practically impossible. In fact, hybrids from such crosses have never yet been obtained

G. A.

23. The Occurrence of Gigantism in Oats.

SCHIGALOW, S. in *Zeitschrift für Induktive Abstammungs- und Vererbungslehre*, Vol. XXIX, Parts 3-4. pp. 207-208 Berlin, 1922.

At the Phytotechnical Station annexed to the Moscow Agricultural Institute, an absolutely constant pure line of oats derived from *Avena orientalis* Schreb var. *obsuala* A 1 was found under cultivation.

In 1911, three families of this line were sown two of which proved pure and typical whereas the third gave rise to 26.1 % of aberrant individuals. These plants were distinguished by gigantism, they possessed a double number of nodes, very thick culms and broad laminae; their growth was rather late, so that the inflorescences were not formed by the time that the first autumn cold set in.

The two constant families remained pure to type also in the following years. The normal plants of the third family produced, on the other hand, a mixed progeny of normal and of giant individuals. The giant plants were in the proportion of 19.7 %, a ratio which remained unaltered during succeeding years (17.6 ; 21.2 %).

By growing the plants in small pots with poor soil, the author succeeded in forcing the giant types to flower. The inflorescences of these plants were distinguished by many peculiar characters, such as the presence of stout awns (98 % of the panicle was awned) which were recurved

at the base. The anthers contained pollen-grains which were for the most part empty, thus explaining the almost complete sterility, as there were 3-5 sterile Caryopsides per plant.

The grain of these oats produced giant individuals. We have here most probably, a mutation arising in a line which is pure and in a heterozygous condition. The death of a large number of the giant plants during the early stages of their development accounts for the number of mutants being a little below what was theoretically calculated (25 %). It is possible that the unusual development of the vegetative organs may be due in the present case to modifications of the sexual organs.

The number of chromosomes in the nucleus of the giant and of the normal forms, is, however, the same. G. A.

24. An F_1 Polymorph Generation from a Cross between *Phaseolus vulgaris* and *Phaseolus multiflorus*.

UPHOF, TH J C in *Zeitschrift für Induktive Abstammungs- und Vererbungslehre*, Vol XXIX, Part 3-4, pp 180-192, figs 5 Berlin, 1922.

This is a description of a very interesting case of polymorphism in the F_1 of a cross between *Phaseolus vulgaris* and *Phaseolus multiflorus*.

The following crosses were made with positive results :

- | | | | | | |
|----|---------------------------|-------------------|---|------------------------------|----------------------|
| 1) | <i>Phaseolus vulgaris</i> | braune Stockbohne | × | <i>Phaseolus multiflorus</i> | (with red flowers) |
| 2) | " | Chevrié | × | " | " |
| 3) | " | Van Celst | × | " | (with white flowers) |
| 4) | " | Van Celst | × | " | red flowers. |

The individuals of the F_1 presented much variety of form. Some were dwarf plants with small leaves, while others were giants greatly resembling in their habit *P. multiflorus*. In addition to the dwarf and giant forms, some individuals were found which had roundish, thick, dark-green leaves.

Amongst the different crosses there were :

1) *Phaseolus vulgaris* "braune Stockbohne" (in pure line) × *Phaseolus multiflorus* with red flowers.

In F_1 , sixteen plants; all climbers like the male parent; seven were giants with red flowers; five were dwarfs. One of the giants was extraordinarily branched and reached the height of 5 metres; it had much larger leaves than either of its parents and flowered freely; self fertile.

As soon as the fruits were 7-10 mm. long they withered and fell off.

Nearly all the plants of this generation developed well formed fruits and seed. The pods were somewhat distended at the distal end, and contained 1-2 seeds similar in shape and size to those of *Phaseolus vulgaris* but much resembling in colour the seeds of *P. multiflorus*.

2) *Phaseolus vulgaris* Chevrier × *Phaseolus multiflorus* (red flowered): of the 34 F_1 individuals, 4 were dwarf with small flowers, 13 had the habit of *P. multiflorus* and 17 were intermediate in character as regards their parents. Pods and seeds were the same as in the preceding case.

3) *Phaseolus vulgaris* Van Celst \times *Phaseolus multiflorus* (with white flowers)

Out of 21 F_1 plants, there were four giant forms with the habit of *P. multiflorus*, and fifteen dwarfs with small leaves (all were equally climbers), and finally, two with brownish-green, serrated, somewhat round leaves. These two plants proved on examination under the microscope to have palisade cells twice as long as those of the other plants, there was no difference in the parenchyma. Flowers white.

4) *Phaseolus vulgaris* van Celst \times *Phaseolus multiflorus* (with red flowers). Out of the 27 F_1 plants, three were giants and the rest dwarfs.

The author emphasises the advisability of repeating these experiments, and of also making cytological investigations with a view to the discovery of the cause of these phenomena.

G A

25 Genetic Analysis Schemes of Co-operation and Multiple Allelomorphs of *Linum usitatissimum*.

TAMMIS '1 *Journal of Genetics*, Vol. 12 No. 1, pp. 19-46 Cambridge, 1922

For *Linum usitatissimum* eight factors have now been determined A, B', C', D, E, F, G and H influencing the colour, shape and breadth of the petal and the colour of the anther and the seed-coat. These factors co-operate in various ways to bring about the characters mentioned.

For the colour of the petal six of the factors namely A, B', C', D, E and F co-operate.

The colour caused by B' and C' is extremely light pink, hardly distinguishable to the eye from white. A and E are intensification factors of the colour. In each other's presence they act accumulatively. The action of E is stronger than that of A .

The intensifying action of A is different for various complexes of factors. When B', C', D and F are present A dominates a , when B', C' and F are present a dominates A . D modifies the pink colour caused by B' and C' into lilac. F changes the lilac colour produced by B', C' and D into blue.

The blue colour of the anthers is dependent on the co-operation of the factors B', D and H , if one of these is absent the anthers are yellow whilst the brown colour of the seed-coat is produced by a complex of factors indicated with G . If G is absent the seed-coat is colourless and transparent and the seed yellow.

The action of G is inhibited by D , in the presence of both G and D the seed is greyish-green. The inhibitory action of D is neutralised by B' .

C' and D together cause the crimpiness of the petal, an action neutralised by B', C' and D together inhibit the factors for breadth of the petal, an action which is prevented by B' .

The 64 genetically different forms with coloured flowers show 40 different phenotypes, the 192 white coloured genotypes show 6 different phenotypes.

The common blue-flowering flax possesses all of the eight factors. All

other forms mentioned in this paper are *loss-mutants*; they are distinguished by the lack of one or two factors of the common blue-flowering type.

The seven factors: *A*, *B'*, *C'*, *D*, *E*, *F* and *H* may lie in seven different and must lie in at least three different chromosomes, the haploid number of chromosomes being 15.

Besides the 16 different forms obtained by different combinations of the factors *A*, *D*, *E* and *F* with the complex *B'*, *C'* there exist for the colour of the petal a great number of others, which may be divided into three series: blue, light-blue or lilac forms.

Three series of multiple allelomorphs, each series consisting of four, have been determined (MORGAN). G. A.

26. A Cytological Research of some Species and Species Hybrids in the Genus *Saccharum*.

BREMER, G. Een cytologisch onderzoek van eenige soorten en soortsbastarden van het geslacht *Saccharum* *Archief voor de Suikerindustrie in Nederlandsch-Indië*, Mededeelingen van het Proefstation voor de Java-suikerindustrie. Jaargang 1922, No. 1, pp. 1-111, 92 illustrations

In raising seedlings of sugar cane at the Sugar Experimental Station at Pasoeroean (Java), species hybridisation has been practised already for many years. Crossings were made between genuine wild species of *Saccharum* (for instance *S. spontaneum*) and the commonly cultivated varieties of *Saccharum officinarum*, but also some wild varieties were used, which are probably species hybrids.

The author found that the species of this genus, hitherto examined, have different chromosome numbers and that a classification based on the chromosome numbers corresponds with one based on the outer morphological characteristics.

The author studied the haploid chromosome numbers in the pollen mother cells. The haploid number of *Saccharum spontaneum*, a wild growing species, is 56. The reduction division occurs in a normal way. In five special varieties of *Saccharum officinarum*, which differ widely in outer characteristics, the haploid number is 40, but frequently a varying number of these chromosomes is not conjugated in the pollen mothercells; these chromosomes remain univalent and surround the gemin in the equatorial plates. The partners of the bivalent chromosomes first pass to the poles; the univalents lagging a little, divide in two parts, which also pass to the poles. Nuclear division in this form results in daughter-cells with a number of chromosomes larger than the true haploid number. Probably by the homotypic division the pollen grains also possess a number of chromosomes larger than 40.

Saccharum officinarum often shows a male sterility in high degree. To the author it seems not improbable, that a relation exists between this sterility and the abnormal chromosome numbers and combinations in the pollen cells, described above.

A preliminary research showed, that two Dutch-Indian varieties of *Saccharum*, with the vernacular names "of Loethers" and "Teboe hitem

Rokan", differing in outer characteristics somewhat from *Saccharum officinarum*, have other chromosome numbers than the later species. Two varieties from British India, "Chunnee", and "Ruckree", differing also from *Saccharum officinarum* have 46 chromosomes haploid.

In species hybrids of other genera, which have been investigated up till now, the number of chromosomes proved generally to be the total of the haploid numbers of the parents.

Hybrids of *Saccharum officinarum* \times *S. spontaneum* are easily obtained in large numbers. Almost all of them are fertile in a high degree. Male sterility is rarely found, female sterility never. The author found, that the somatic chromosome number of several of those hybrids was 136, the total of the diploid chromosome number of *Saccharum officinarum* and the haploid number of *Saccharum spontaneum*. Normal reduction division occurs, the haploid number being 68. The author thinks it probable that the normal reduction division may be the reason of the fertility of these hybrids. By morphological studies in the same Experiment Station it had already been concluded that the wild Kassoer cane was a hybrid of *Saccharum spontaneum* and *Saccharum officinarum*. The haploid chromosome number of Kassoer really appeared to be 68, in full accordance with the number found in artificial crossing between the same species.

In the megaspore-mother cells of *Saccharum officinarum* a normal reduction division was always seen, from which the author concludes, that a longitudinal splitting of the *Saccharum officinarum* chromosomes in the egg cell during fecundation may be responsible for the increase of the number of chromosomes of the hybrid plants. One could mention in this case the heterotriploid hybrids.

The volumes of the nuclei of the pollen mothercells of *Saccharum officinarum*, *S. spontaneum* and *S. officinarum* \times *S. spontaneum* are in accordance with the chromosome numbers. The chief conclusions are:

- 1) The species and varieties of sugar cane showing different outer morphological characteristics also differ in number of chromosomes;
- 2) *Saccharum* may form species hybrids showing a chromosome number, being the total of twice the haploid number of the mother and once the haploid number of the father.

I. K.

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This monograph contains a detailed description of the genus *Lolium*, fam. *Hordeaceae*.

D. v. S.,

CROPS IN TEMPERATE AND TROPICAL COUNTRIES (INCLUDING FORESTRY)

SYNTHETIC ARTICLE.

28. Oil Yielding plants.

I. — PIERAERTS, S. Les Irvingia oleifères. — *Bulletin Agricole du Congo Belge*, Vol. XIII; pp. 68-82. Brussels, 1922.

II. — KOPP, M. Etudes sur l'Arachide, with Preface by M. Chevalier. *Bulletin de Matières Grasses de l'Institut Colonial de Marseilles*, No. 6, pp. 131-174. Marseilles, 1922.

III. — AMMANN, and DENIS. L'Arachide aux Etats Unis (Extrait d'un rapport de Mission). *Ibid.* No. 8, pp. 207-221. Marseilles, 1922.

IV. — BAUDON, A. Les graines de Cucurbitacées oléagineuses. *Bulletin de Matières Grasses de l'Institut Colonial de Marseilles*, No. 8, pp. 227-231. Marseilles, 1922.

V. — CREVOST, CH. and LEMARIE, CH. Catalogue des produits de l'Indochine, Group III. Matières Grasses Oléagineuses. *Bulletin Economique de l'Indochine*. Year XXV, pp. 141-159 + figs. Hanoi-Haiphong, 1922.

The Fam. Simarubaceae includes several species with oleaginous seeds in some cases in the form of fatty oils and in others as liquid oils.

The most important plants belong to the gen. *Irvingia* (1) and the two chief species originate in West Africa and Asia respectively.

1) *Irvingia gabonensis* Baill (= *I. Barteri*, Hook. = *Mangifera gabonensis* A. Leconte) 25 to 30 m. in height — found in Sierra Leone at Gaboon, in the Belgian Congo, in the French Congo and in the Cameroons. The fruit is known by the local names of "oba", "iba", "ondago" and "dago", "indika", "dika", "dita", bwila, "bwila bambale", "weke" and andoon-dog, miba and wueba.

The fruit is green, the size of an apple, square-shaped, with a juicy pulp, a turpentine flavour and has large fibrous seed similar to an almond with a pleasant but slightly bitter flavour.

According to HECKEL *I. gabonensis* is not to be found in the Belgian Congo or near the Equator, but another species, *I. Smithii* Hok. f. has been found, known locally as "bofetele".

The Asiatic species *Irvingia Oliveri* Pierre is abundant in the forests of Cambodia, in Cochin-China and in Southern Annam. In Cambodia it is known as "cham-bac" and in Annam as "cay-cay" and "moc-toug". The trees grow to a height of 30-35 metres. The fruit has a fibrous pulp and almond nut with a very hard endocarp.

The nuts of both *Irvingia* spp. contain identical proportions of 20 % seed and 80 % husk. The fatty material from *I. gabonensis* is called "Dika butter", "Dika" or "Oba oil", and when fresh is white and has a faint odour, and pleasant flavour. After a certain time it turns yellow and rancid and finally becomes a greyish-yellow. The fat content is very variable, 54 to 67 %. HECKEL, with carbon disulphide has obtained 21 % butter fat from the nut and 48 % from the seed. According to MILLIAUX,

the Dika nut contains 66.8 % butter fat of which 56 to 59 % is of commercial value. The natives split, heat, and grind the seed and mix the extract with boiling water.

The fatty oil from the Asiatic species is termed "cay-cay butter", "cay-cay wax", "Cochinchina wax", "Irvingia butter", and "Candlenut butter". The appearance is crystalline, whitish-grey-yellowish and greasy; the oil has a distinctive odour which disappears on exposure to air and light.

BOUTOUX by using petroleum ether has extracted 60.45 % of fatty oil; HECKEL 61 % with carbon disulphide; SCHLAGDENHAUFFEN up to 73.60 %; BENEDICK, 10.6 % of butter fat from the nut, and 52-56.7 % from the seed.

An analysis made at the Institut Pasteur at Saigon reports 65.68 % to 74.32 % butter fat. The natives adopt the same methods of preparation as the African natives employ in the case of Dika butter fat.

The following conclusions may be drawn:

1) Dika butter fat contains a minimum proportion of liquid glyceride; probably olein.

2) Being formed almost entirely of glycerides and of non-volatile acids it presents a remarkable homogeneity and the composition remains very constant.

3) The volatile acids enter very little into the composition of Dika butter.

4) The mixed, non-volatile fatty acids possess a molecular weight inferior to that of stearic or palmitic acids.

MILLAUX estimates — 20 % lauric acid and allied acids, 69 % myristic acid, 11 % oleic acid.

The composition and constants for cay-cay butter-fat do not differ much from that of *Irvingia africana*. BOUTOUX states that it contains 30-35 % laurein and 60 to 65 %, myristin.

Both these fats possess a high nutritive value, especially the Dika fat which is easily digested, and keeps well.

The negroes are very fond of the seeds of *I. gabonensis* and utilise them to make a kind of Dika confection, known as Gaboon chocolate. Prof. MARCHAND states that this is composed also of Oba almonds and seeds of *Mangifera africana* and of *Pentaclethra macrophylla*. The seeds are ground and made into a paste in a vessel lined with banana leaves, and baked over a slow fire. The paste takes a cylindrical form, turns brown, with dark and light blotches and is greasy to touch; it weighs about 6 kg. and the cakes are exposed for some time to the action of smoke and acquire a greyish-brown colour with a flavour resembling dried cacao and toasted almonds.

The author is not certain if Dika cake is prepared in the Belgium Congo. He considers that the oil may be utilised commercially in:—

1) The manufacture of soaps; it is superior to copra.

3) The preparation of chemicals or cosmetics (pomade, cold-creams etc.).

3) As a substitute for cacao fat.

4) The manufacture of butters and other nutritive fats.

5) Certain operations in connection with the preparation of skins.

It may be used to replace stearin, owing to the high myristic acid content.

The cake, after extraction of fats contains 22.66 % protein ; 30.87 % starch, 7.97 % ash ; and also a certain fat residue which may be used as a food for human beings and for animals.

The cay-cay butter fat is utilised only in the country of origin, chiefly for making candles. This, however, is losing its importance owing to the wider use of paraffin. The oil cake has a composition similar to the Dika oil cake and the cotton cake.

The author concludes therefore that a further study with regard to the utilisation of Dika butter fat should be of distinct value with a view to the present needs, the butter should be manufactured in the country of origin as the nut consists of 80 % husk, and the consequent cost of transport should be considered.

Professor CHEVALIER in his preface to KOPP's book sets out the main points to be followed in the study of the means of improvement for a cultivated plant.

These may be divided under three headings: 1) documentation, 2) research, 3) experiment. KOPP's work consists solely of the results he could obtain in the field of documentation after examining, collecting and discussing the work done by previous students.

The groundnut (*Arachis hypogaea* L.) belongs to a family of plants, numbering to-day ten species and all originating in tropical America. Certain authorities consider that two types should be distinguished: one (*A. africana* Lour) which is common in the countries on the Atlantic coast and originates in Brazil, the other (*A. asiatica* Lour) which originates in Peru and is to be found on the coasts of the Pacific and Indian Oceans. The main differences between the types are to be found in their habit, the number of seeds (three in *A. asiatica*, two in *A. africana*) and in the colour of the skin (light-red in *A. africana*, dark-red in *A. asiatica*).

Numerous varieties are to be found in Africa, America and Asia, which should be collected and studied systematically in their botanical, agricultural and commercial aspects.

The groundnut should be sown without the husk to accelerate germination.

As regards climate it is mostly cultivated in the inter-tropical zones but it also does well in the sub-temperate. In Senegal the most favourable conditions are realised with a rainfall of 50 cm. spread at the 3 ½ months preceding maturity but fair results are also obtained with a rainfall of 25-30 cm. In India it is a rainy season crop but it can also be cultivated by irrigation methods in the dry season. In the United States five months without frost are necessary. The soil must be porous and light to allow the flowers to penetrate at the time of fructification.

Caution is required in the use of nitrogenous fertilisers as the radical tubercles lend themselves to the assimilation of atmospheric nitrogen and an excess of nitrogen causes an undue leaf development at the expense

of the fruit. Amongst mineral elements, lime is the most important and is used in large quantities in soils that are poorly supplied or entirely deficient. Phosphoric acid and potash are also important for the proper growth of the ground-nut.

Crop-rotation is essential in its cultivation as it is a nitrogen fixing plant: the rotation necessarily varies according to the actual requirements of different countries. In practical cultural work two important requirements must always be borne in mind.

- 1) The checking of weed-growth which prevents the flowers from penetrating the soil.

- 2) The keeping the soil sufficiently moist during the dry season.

As a result the methods of cultivation show a remarkable similarity in the various countries. Differences consist mainly in the actual means employed for carrying out the various processes, for instance in certain countries such as the United States a considerable use is made of machines. In the colonies, however, mechanical methods are very difficult to follow on account of prime costs, the need for skilled mechanics, who require high wages and also because of the difficulty of carrying out repairs on the spot, the varied nature of the soil (in Senegal for example deep ploughing is impossible on account of the thin layer of cultivable soil), and also difficulties with animal traction due to epidemic disease.

Groundnuts are liable to various diseases (more numerous where the area under cultivation is the most extensive), due to bacteria, fungi (especially destructive to the American crop), parasitic flowering plants or other weeds, insects, which cause damage to the plant both above and below the soil as well as to the fruit in the ground and the seeds in storage. Certain vertebrates, for instance quails, mice, jackals and monkeys are also the cause of considerable losses.

Up to the present, systematic selection work has not been carried out though the question is of great importance for the future of the crop. The foundations of this work rest on an accurate botanical study of all the varieties and types grown in the different countries for thus only can a sure beginning be made with future experiments.

In commerce the African groundnut is of very mixed quality and it is necessary to consider the means for obtaining a more uniform standard.

In the United States a standard has been fixed for groundnuts used in oil manufacture, four types being distinguished, viz. White Spanish, Bunch, Runner, and Mixed with three qualities in each case, based on the percentage of ripe, healthy pods. The superior quality must contain at least 72.5 — 77.5 % of such pods, the average 65-70 % and the inferior 60-65 %. A consignment is rejected and classed as "mixed" if it contains more than 70 % of moisture, more than 5 % of damaged pods, any red pods, more than 2 % of other varieties, and more than 2 % of uncrushed specimens.

The groundnuts sold for food purposes or for butter making are divided into three grades according to type of nut and seed. The average composition of the groundnut is given as follows: (THOMSON and BAILEY):

Va-ri-ety	Moisture	Oil	Ash	Proteins	Fibre
Virginia	4.1 %	43.3 %	2.7 %	29.5 %	2.30 %
Spanish	3.9 %	52.5 %	2.4 %	32.0 %	2.75 %

In England and the United States, a large quantity of roasted groundnuts (unhusked) are consumed; cracked, and salted, and also as a substitute for hazel nuts in cakes, and in Spain in the manufacture of nut-chocolate.

The larger part of groundnuts imported into Europe are used for oil extraction, for the sardine industry, and for margarine in Holland. It is also utilisable as a lubricator and as a coating for materials etc.

In the United States, the ground nuts are commonly used to make butter: in 1919 about 6 million pounds was produced.

The oil cakes are used as a stock feed and the high protein content renders it valuable, it ranks between cotton and palm oil as regards carbohydrate value. The meal may be ground also and the flour serves as an article of food which, when mixed with wheat flour or cassava gives an excellent result.

The groundnut hay is considered of good value in the United States and when harvested ripe contains: 31-32 % moisture, 12 % ash, 10 % protein, 32 % fibre, 40 % carbohydrate, 5 % fats, 1.70 % nitrate.

The world production of groundnut amounts to about 2 million tons (China not included).

Senegal exported 174 000 tons in 1910, and about 350 000 tons in 1920. The French Soudan exported 10 000 tons in 1920; PERRUCHOT reports a yield of 15 000 to 1 800 kg. of nuts per hectare. ADAM quotes 1 000 kg., and FLURY, 3 000 to 4 500 kg. in Baol and as much as 11 000 kg. in certain areas. In India the production 1919-20 was 898 200 tons from 635 000 ha, three quarters of which comes from Prov. of Madras. In the United States the production in 1920 is stated as 386 097 tons from 494 000 ha.; Gambia exported 71 397 tons in 1919, and Nigeria 58 477 tons.

The author concludes by stating that the production of groundnuts can be increased if attention is given to selection of the best varieties and this necessitates further research and improvements in cultivation methods and organisation as a whole.

A bibliography of 20 works is given with reference to this important oleaginous crop.

III. — The report of the Mission to study the conditions for groundnut cultivation in the United States.

The most suitable soil is of medium texture, with plenty of lime and a well-drained clay subsoil. An absence of frost is important, and an abundance of sunshine and mean atmospheric moisture; sowings should be made when there is no danger whatever of frost.

The cultivation operations must be carried out thoroughly; they vary according to the preceding crops, for sometimes groundnuts follow maize in the rotation, while at others, they come after oats. The soil should be well pulverised and the work done on the flat, except on rather

damp soils, or in districts where heavy rain is to be feared, in which cases, it is well to sow the groundnuts on small ridges.

The lime and chemical fertilisers are spread in the furrows traced by the marker where the groundnuts are to be planted.

The general formula is :

90 kg. cottonseed.

90 kg. calcium phosphate.

170 kg. kainit.

This fertiliser is applied at the rate of 9.5 kg. per hectare ; its price during the current year was 60 dollars per ton. The use of stable-manure is not advisable.

It is a bad plan to hill up the soil round the root-collar of the plants, as it causes the flowers to be on a level with the ground, so that they are spoilt by the soil.

The ground should be well cleared of weeds before the flowering season, for it is very troublesome to gather groundnuts on land infested with weeds.

Groundnuts can be grown in rows, and the same implements may be used for them as are employed in the case of maize and cotton. A special apparatus known as the "weeder", has however been made (the best type is manufactured by Avery and Sons, Louisville, Indiana). This is excellent for uprooting the weeds, it also pulverises the soil at the same time, thus preserving the humidity of the ground. For the latter reason, this apparatus is to be recommended for dry-farming, and the authors have advocated its introduction into Senegal. Another implement is the "Sweep", this is used for the subsequent cleaning of the land.

As the quality of the seed is a most important factor, the Americans are working at the experiment Station to produce plants bearing a large number of pods, each containing a constant number of seeds. Mr. MILLER, Director of the Pee Dee Station near Florence, has obtained the best results in the case of the Spanish variety with pods containing two seeds, because this character is the most constant, whereas pods with 1 to 3 seed do not reproduce themselves regularly. Groundnuts should be shelled 1 to 2 days before planting but not sooner, as MILLER'S experiments have shown a longer exposure to be injurious. Some growers prefer sowing peanuts unshelled (an apparatus is being manufactured for the purpose), for in this condition they are more resistant to possible adverse conditions due to drought. Unshelled groundnuts should not be wetted, unless they are planted immediately afterwards.

In Virginia and North Carolina, the chief time for sowing is at the beginning of May ; in the south the sowing period is longer, and lasts from the middle of April to July 1 according to the different States. The nuts are planted at depths ranging from 1 in. to 1 ½ in in heavy soils, and at 2 inches in light soils. If the ground is damp, the seeds must not be planted so deep. The amount of seed used varies according to circumstances ; about 35 kg. of shelled nuts of the value of 15 dollars of the Spanish variety are sown per hectare. The best sower is the Ap-

pomatox Perfect Peanut Planter, it is made at Petersburg (Virginia), costs 25 dollars, and will plant $1\frac{1}{2}$ hectares a day.

The crop should be carefully harvested when most of pods are ripe; the plants must be pulled up by hand, as all the present lifting implements are very defective. Care ought to be taken to finish the harvest before the bad weather sets in, and before the seeds begin to germinate in the over-ripe pods.

The Americans put the plants, when lifted, into small heaps (after leaving them for some hours on the ground to dry) where they remain for 2 or 4 weeks. This is termed "curing". The heaps are nearly of a man's height, and are covered with dry hay. At the above-mentioned Experiment Station of Pee Dee, experiments are in progress to determine the conditions under which this curing should be carried out, and the advantages of the process which is costly and is not adopted on all farms.

The threshing is now done by machine; the best apparatus appears to be the Lilliston, of the National Machine Corporation of Suffolk (Va.). This required 6 to 7 HP. and 5 men to handle it. The Lilliston costs 550 dollars, and yields 72 hectolitres per 10 hours day.

With the threshing, the grower's task is finished, for the further processes of cleaning and shelling are carried out at the commercial establishments.

The yield of groundnuts varies from one district to another, and even from farm to farm, and has been increased by the crises in agricultural labour. The cost of cultivation, harvesting and threshing amounts, according to different writers, to 46.75, 50, or even 57 dollars per acre.

Chinese competition is a serious danger to American groundnut growers, for in order to be profitable, the American product cannot be sold for less than 140 dollars per ton, whereas the Chinese can afford to sell their peanuts for 100-110 dollars per ton. In the United States, the peanut crops suffer little injury from diseases, although they are not uncommon. A disease due to *Sclerotium rolfsii* was discovered, in 1915, in Norfolk (Virginia) where it appears to have been introduced with seed from Valencia. Certain varieties are however resistant to this malady.

The authors conclude their report with some remarks concerning the improvements that could be introduced into Senegal, basing their statements on the results of research, and on practical work carried out in America.

BADON (IV) gives some information regarding the seeds of some African cucurbitaceae that produce an excellent table oil. The natives grow these cucurbitaceae among their crops of millet, sorghum and other cereals, and manioc. The kinds most cultivated are: different varieties of *Citrullus vulgaris* Schred, *Cucumeropsis Mannii* Naud, and *Cladoscyclos edulis* Hook.

The vegetative period of these plants lasts from 120-140 days. They should yield not less than 10 quintals per hectare. The fruits of *Citrullus* are from 10-15 cm. in diameter, and those of the other Cucurbitaceae from 4-5 cm. The natives soak the fruits in water and then collect the seeds which are dried in the sun. Before use, the seeds are slightly roast-

ed and then ground in a mortar to reduce them to flour from which the oil is extracted by hand pressure.

PIERAERTS of Brussels, who has studied the *Citrullus* oil of the Belgian Congo, found that 100 of the seeds weighed 12 gm; 75 % of the weight being made up by the kernel, and 22 % by the shell. The oil content is said to amount to 37.5 % of the weight of the seed and 50.46 % of the decorticated kernel.

These oils, when well prepared by the natives, are yellow, inodorous, of agreeable flavour, and do not turn sour. They can be used in soap making and for the extraction of glycerine, but are of little good in the stearine factory owing to their low percentage of solid fatty acids. The French African Colonists obtain their table oil from France, but they could very well use these native products if they were prepared according to modern ideas and methods.

This part of the list of the products of Indo-China has been compiled by CREVOST and LEMARIÉ and deals exclusively with plants supplying fluid oils (V).

During the last decade, Indo-China has exported the following oleaginous products.

Year	Seeds		Oil		Oil cakes	
	Tons	Pcs.	Tons	Pcs.	Tons	Pcs.
1910	8219	2361000	866	441005	107	10700
1911	7854	2564000	778	396000	115	11500
1912	10069	2833000	607	517550	590	59000
1913	8057	2192000	805	429000	304	30400
1914	11923	3199000	1324	672000	352	35200
1915	9161	2644000	1244	640000	160	16000
1916	6734	2435500	1043	740000	140	14600
1917	3215	1391784	805	702652	134	13400
1918	4514	1574602	2724	731140	98	9850
1919	3692	3031712	3607	6943226	81	16284
1920	5089	4248749	1861	3353122	150	25057

The above figures are of distinct importance and with the introduction of modern industrial methods deserve special attention.

The most important species are: For Amoor, *Amoor gigantea* Pierre = *Aglaia gigantea* Pellegr. (Meliaceae). For Tonkin goi, cas, now scarce the seeds supply a dark brown oil, useful for illumination.

Arachis hypogaea Linn. *A. asiatica* Lour. *A. africana* Lour. — Cochin and Annam: dau phône; Tonkin: cu lac; Cambodia: sandekdey; China: thon-than; Japan: nankin mame, tojin mame. A large quantity of unhusked seed and oil is exported:

Badamia, *Terminalia Catappa* Linn.; *T. Badamia* Tul.; *T. moluccana* Lurk.; *T. Myrobalana* Roth.; *T. subcordata* Willd.; *T. intermedia* Spring; *Juglans Catappa* Lour.; *Catappa domestica*, *litorea* and *sylvestris* Rumph; *Badamia Commersoni* Gartn. (Combretaceae).

Annam: bâng; Cambodia, chachaut, chu ho tzu; Japan: momo, Tamana sima-ho; Kohateishi.

The oil may be used as a substitute for sweet almond oil.

Bancouliers (*Aleurites*). This genus of Euphorbaceae includes several oleaginous species; the chief being:—

Aleurites montana Wils; *Vernicia montana* Lour; *Dryandra oleifera* Mamk; *D. vernicia*; *Elococcus Vernicia* Ad. Suss. Stead; *Aleurites Vernicia* Hask; *A. cordata* Mull. Arg.

Annam; trau; dau son; dong; ngo dong; cin; mon-yeou. The oil is only slightly liquefied, colour yellow-pink; drying easily. In China this oil is used for waterproofing fabrics. The seed consists of 46.74 % husk and 52 % seed gives 19 % oil and 62.5 % oil cake.

Aleurites moluccana Willd.; *A. triloba* Forst.; *A. ambinux* Pers.; *A. cordifolia*, Steud; *Camirun cordifolium* Gaertn; *Juglans Camirun* Lour; *Jatropha moluccana* Lin.: 3-lobed bancoulier, Camiri; Noyer des Moluques, Candle nut; Annam: lai; thai; ly; Chinese: shihli; Japanese sekiritsu.

The seeds contain a fairly strong purgative which remains almost entirely in the oil cake. According to PARCETE, 100 kg. of nuts give 7-10 kg. seeds and 100 kg. seeds is estimated to give 40-55 kg oil. After drying in the sun an average of 63 to 65 % of oil should be obtained. This oil is clear; has a pleasant odour; is straw coloured when obtained by expression, golden yellow when extracted with petrol ether. It can be used commercially in soap-making and as a substitute for linseed oil for oil painting.

Aleurites Fordii Hemsl.; cin; tong-yeou. Introduced into Tonkin from China and exported in large quantities as "wood oil of China".

Ben ailé, *Moringia Pterygosperma* Gaertn; *M. oleifera* Lamk; *M. Zeilanica* Pers; *M. polygona* D. C.; *Hyperanthera Moringa* Vahl; *A. decandra* Willd.; *Guilandina Moringa* Lin. (Moringaceae). This plant grows wild in the South of Annam and in Cochinchina. The seeds contain 36 % of clear oil, limpid, almost colourless; considered one of the best lubricating oils for machinery.

Bonduc. Two *Caesalpinaceae* go by this name:— *Caesalpinia Bonducella* Flém; *C. Godefroyana* Kuntz; *C. cristata* L. Merrill; *Guilandina Bonducella* Linn. Petit Bonduc: Tonkin: wiot hum; China: nam sie toc; Japan: sturotsubu; *Caesalpinia Bonduc* Roxb; *C. glabra* Merrill; *Guilandina Bonduc* Linn. Grand Bonduc.

The oils are utilised as cosmetics and for medicinal purposes.

F. C.

Crops.

29. Effect of Cupric Treatments on the Wheat Yield.

MORETTINI, A *Influenza dei trattamenti cuprici sulla produttività del frumento* *Le Stazioni sperimentali agrarie italiane*, Vol I.V, Pts 7-8-9, pp. 265-277. Modena, 1922.

In a preceding article (*Stazioni sperimentali agrarie italiane*, 1921), the author has shown the advantage of substituting "polvere Caffaro"

(oxychloride of copper), or powdered copper carbonate (1), for the usual treatment with a solution of copper sulphate in the control of Smut (*Tilletia Tritici*). Experiments have proved that the dry treatment prevents smut without in any way injuring the germinating capacity of wheat. It has also been shown that germination after immersion in a 0.5 to 1.5 % solution of copper sulphate is not affected. This fact is confirmed by other investigators (KRAUSS, WOLLNY, KIDD and WEST); others consider it has an injurious effect (DARNELL-SMITH and ROSS; MACKIE and BRIGGS), and others again maintain that it is actually beneficial (HARRY).

Results in agreement with the author have been obtained by G. D'IPPOLITO (*Riforma agraria*, No. 6, 1920; *Stazioni sperimentali agrarie italiane*, p. 293, 1921).

In the present case, the author proposed to investigate the effect of the two methods of treatment (with solution or with powder) upon the productivity of wheat, without any reference to their resistance to disease.

Three varieties, one an autumn wheat (Gentil rosso semiaristato, 48), two spring wheats (one soft "marzuolo ferrarese", one hard "timilia di Sicilia"), were each divided into 5 lots treated respectively as follows: 1) control; 2) immersed in water for 17 minutes, then allowed to dry in the air; 3) immersed in a 0.5 % solution of copper sulphate for 15 minutes, then for 2 minutes in milk of lime and allowed to dry; 4) mixed dry with 3‰ by weight of Caffaro powder; 5) mixed dry with 3‰ of copper carbonate.

The seed was sown 12 days after treatment. The growth was somewhat hindered by the dry spring.

The following results were obtained with the 5 treatments (quintals per hectare). Gentil rosso: Grain: 15.00; 15.04; 15.00; 15.52; 15.82; straw + chaff: 72.67; 70.24; 74.58; 72.39; 73.35.

Marzuolo ferrarese: Grain: 12.66; 13.00; 13.66; 14.13; 15.56; straw + chaff: 28.66; 29.33; 29.33; 36.10; 31.43.

Timilia: Grain: 17.20; 17.00; 17.53; 17.66; 18.54; straw + chaff: 34.13; 32.50; 38.82; 31.66; 32.46.

The three series of results agree in showing a higher yield for the seed treated with powder as compared with untreated seed, or with water, or with a solution of copper sulphate. Of the fungicides employed, the copper carbonate gave the best results.

By means of germination tests made with seed subjected to different treatments, the author has ascertained that the increased yield following the dry treatment is due to an increase in the germination capacity. The difference between the germination capacity of the control seed and of that of the seed treated by the dry process was, on an average, 2 to 3 % with copper carbonate and 2 % for "polvere Caffaro".

The increased yield in both cases appears to be due chiefly to the toxic action of the two copper compounds upon the moulds and bacteria that attack the germinating cariosis and these compounds have no injurious effect on the embryo. This allows the grain to develop a higher germi-

(1) See R. 1921, No. 44. (Ed)

native capacity; it is possible also that the copper may exercise a stimulative effect upon the growth of the seedling.

In conclusion the author recommends the use of powder fungicides rather than solution. F. D.

30. Potential Wheat Production Lost in the United States.

One third of Potential Wheat Production Lost: Adverse Weather Conditions, Insects, Animals, Poor Seeds, and Pests Exact Heavy Toll. *Weather. Crops and Markets*, Vol. II, No. 24, pp. 497-507. Washington, D. C., 1922,

The average yearly wheat crop of 781 359 000 bus. produced during the 13 years from 1909 to 1921, inclusive, was what remained from a potential crop of 1 230 000 000 bus. In other words, the production of 449 000 000 bus. was prevented by various causes. Among the things wheat farmers had to contend with were too much or too little moisture in the ground, late frosts in the spring and early frosts in the fall, and hot winds, hail, floods, and storms. Production was reduced also because of defective seed, plant diseases, and the devastations of insect and animal pests.

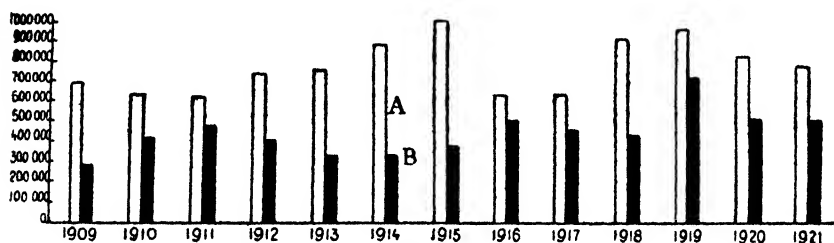


FIG. 19 — Percentage of wheat damaged through various causes in the United States.

A. — Wheat in good condition.

B. — Wheat in inferior condition.

In consequence of these various causes of damage to the wheat crop, the potential crop was reduced on an average about 36 % for the 13 years. That is to say, the farmer set out to raise 100 bus. of wheat, and for the reasons given he failed to raise 36 bus. and actually harvested 64 bus. For every bushel of wheat grown, somewhat over one-third bushel failed to reach maturity. These conclusions are warranted by investigations by the U. S. Department of Agriculture. The largest potential wheat crop was one of about 1 707 000 000 bus. in 1919, although the harvest of 968 000 000 bus. in that year was exceeded in 1915 when the harvest was 1 026 000 000 bus. Usually a large crop of wheat is due to a relatively low prevention of production but, of course, the production of the crop is also related to acreage.

During the 13 years under consideration the lowest degree of preven-

tion of wheat production was 27 % of a potential production in 1915 and the highest was 44.3 % of a potential production in 1916. Within the period covered by the record of the Department from about one-fourth to nearly one-half of a potential wheat production has failed to be realised. The average is a little more than one-third. If the farmer could secure a potential production of wheat, he could get from about two acres the crop that he now harvests from about three acres. It may properly be assumed however, that the acreage of the wheat crop would be greatly reduced if the potential production could be secured.

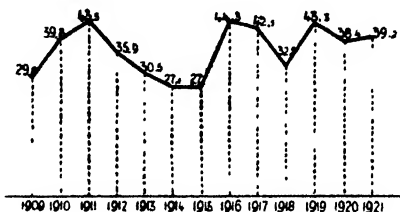


FIG. 20. — Percentage of wheat lost owing to adverse conditions

No value can be given to the wheat the production of which has been prevented, but, for purposes of comparison with the value of the harvested crop, the prevented crop can be multiplied by the same price per bushel with the result that the average harvested crop of the last 13 years had a farm value of \$999 000 000 and the crop lost had a value of \$599 000 000.

G. A. B.

31. Tillering in the Wheat "Romanella".

RUGGIERI, P. R. Alcune osservazioni sull'accestimento dei frument, in generale e della Romanella in particolare *Stazioni sperimentali agrarie* Vol. LV, Parts 10-11-12, pp 447-468. Modena, 1922.

Whether tillering should be encouraged, or hindered in order to obtain the largest wheat yield per hectare is doubtful, as is shown by the author's exhaustive review of the discussions to which it has given rise.

The author gives the results of his recent experiments on the wheat "Romanella" on the alluvial soil of the "Campo sperimentale di Capua", in the Commune of Vitulazio, belonging to the R. Scuola Superiore di Agricoltura at Portici.

The name Romanella is given to a large series of varieties that have arisen, in Terra di Lavoro since the first years of the XVIII century, apparently from Rieti wheat, for this was known as "Romano". Throughout Campania, except upon soil clearly of Vesuvian origin, Romanella has always surpassed all other lines of wheat, both in the quantity and quality of the yield; at the present time, it occupies 54 % of the whole wheat area. Principal characters: length of stems 1.15 to 1.55 m., average

1.40 m.; ears 7 to 15 cm., average 10; 26-50 grains per ear of central culm; normal yield 12 to 20 quintals per hectare; fairly resistant to rust lodging and shelling. The flour makes excellent bread.

In the author's experiments, "Romanella" followed beans and was broadcasted in the middle of November on land that had been prepared by thorough ploughing. The culms per plant were counted in the case of 90 plants, on February 16 (winter tillering), March 27 (spring tillering) and again on May 24 to ascertain the stems with normal and aborted ears respectively, as well as the erect and the lodged stems. On June 17, the crop was harvested. The winter tillering produced 1 to 24 stems per plant. The maximum spring tillering (121 %, taking 100 as the number of stems produced during the winter tillering) was found in plants that had 12 stems; the minimum (87.5 %) in those with 16.

The number of stems with normal ears at the harvest, expressed as a percentage of the stems at the winter tillering, was maximum (100 %) in plants with a single stem at the winter tillering, and minimum (21 %) in those that had 5. The number of aborted stems was disproportionate to the productive energy of the plant. Such abortion does not depend on the number of culms at the winter tillering, in fact in the case of plants with 12 culms on February 16, 63 % of the stems bore good ears at harvest time, while in that of plants with 3 culms on February 16, the percentage was 36.

Hence, freer tillering means a larger number ears and also more grain, but the grain is of slightly inferior quality.

In short, also in the case of "Romanella" the agriculturist should promote liberal tillering.

The greatest amount of tillering is effected in the autumn, afterwards the number of stools remains almost, or quite, stationary, and is reduced to half about the time of harvest.

In 33 plants out of 90, viz., there was only one stem per plant. Average tillering gives about 3 culms per plant. F. D.

32. Observations on the Behaviour of the Langlois Wheat in Algeria in 1922.

DUCELLIER, L. (Professeur à l'Institut agricole d'Algérie). Observations sur le comportement du blé Langlois en Algérie en 1922. *Revue agricole de l'Afrique du Nord*, Year 20, Nos. 170 and 171, pp. 702-706 and 714-717. Algiers, 1922.

The author gives details of the experiments made in several parts of Algeria with Langlois wheat No. 1527, a variety derived in 1907 from the Boghar, Red Themcen and Khala wheats.

The following characteristics are noted:— straw 1 m. to 1.50 m., thick well developed; ear straight, slightly drooping when ripe, length 7 to 9 cm., transverse section 10 to 11 mm. × 13 to 14 mm.; awns stiff, fawn-coloured at the side and round the spikelet, ears red to brown, glabrous, with a glaucous bloom.

Spikelets overlap regularly from base to tip and are placed somewhat

close together, 9 mm. apart on the same side of the rachis, average 20 per ear.

Glumes glabrous, length 13 to 11 mm. including the tip (1 mm.), base clearly cut, rough edged.

Glumelles, base smooth, edges membranous, forked, glumules quadrangular, membranous, rough edged.

Grain hard type, average size 7 to 9 mm., amber coloured, convex, pointed at the base, obtuse at the tip.

Interesting results have been obtained with the Langlois wheat in Morocco, South of France and in Italy.

The following list shows the yields obtained in various districts:

	quintals
Ferme Blanche (Oran) irrigated	21
Cassaigne (Oran) in rows 54 and 18 cm	15
Boularik (Algiers) in rows 14 cm	14
Maison-Carrée (Algiers)	10
Bordj-bon Arreridj (Constantine) in rows 18 18-18 cm	10
Tessalah (Oran)	8 6
Palat (Oran)	5
Berteaux (Constantine)	3

Everywhere the yield has exceeded that obtained from ordinary cultivated varieties.

F. C.

33. Experiments with Autumn and Spring Wheats in La Moncloa, Madrid. (1)

I. — GARCIA ROMERO, A. Ensayos de trigos de invierno y primavera. *Estacion central de Ensayos de Semillas, La Moncloa, Madrid, Buletin trimestral*, Year II, No 7, pp 1-3. Madrid, 1922.

II — Estudio biometrico de algunas variedades de trigos con mira a su mejora, *Ibid*, pp 8-9. Madrid, 1922.

I. — Experiments with 41 autumn and 18 spring wheats. Observations were made on the weight of 10 ears; the grain after harvest; seed husk; straw; number of seeds per 10 ears and per ear; favourable seasons (drought at time of seeding). Average yields: Autumn wheat, 21.57 quintals per hectare of grain and 58.89 qx. straw — spring wheat 7.41 qx. and 37.37 qx. respectively, which was much inferior to the yield of the preceding year. The best results both with autumn and spring wheats were obtained with selected Spanish varieties.

II. — With the 25 varieties tested in 1920-21, 49 new species were obtained in 1921-22. The most promising appears to be the "candeal fino" from Ciudad Real, but the actual fixing of the type is still uncertain.

F. D.

(1) See R. 1921, No. 610 (Ed.)

34. Potash Manures for Rice Fields.

NOVELLI, N. La concimazione potassica al riso. *Il Giornale di Riscicoltura*, Year XII, No. 1, pp. 161-163. Vercelli, 1922.

Some time ago the R. Stazione Sperimentale di Riscicoltura di Vercelli advised the use of potash manures on rice fields. During 1921-22, several farmers followed this recommendation and confirmed the foregoing reports as regards increased production, and resistance to disease and lodging.

One case reported proves that even when potash is on very rich clay soils, with a 3.4 ‰ potash content, the fertiliser gives a profitable returns. Three plots were manured as follows: 1) 6.5 quintals per hectare of leucite containing 13.42 % potash; 2) 2 quintals per hectare of potash salts + 43 % potash; 3) control (no manure). The results were respectively: 82.92; 82.20; and 75.63 quintals per hectare, equivalent to a maximum profit of about 700 lire per hectare. F. D.

35. Cereals grown in Combination for Grain Production.

ZAVITZ, C. A. *Journal of the American Society of Agronomy*, Vol. 14, No. 6, pp. 225-228. Geneva, N. Y., 1922.

In 1922, more than 600 000 acres in Ontario (Canada) were used for mixed cereals. For over a quarter of a century, various experiments have been conducted at the Ontario Agricultural College; the author reports the results obtained in the 6-year experiment with oats, barley, spring-wheat and peas and in various combinations, six mixtures having two classes of grain in each mixture, and one having all four classes; and one with all four combined; this made in all 11 mixtures, besides the four cereals sown separately. The varieties selected matured simultaneously. After cutting and drying these were taken to the barn and threshed. The experiment was conducted in duplicate, thus making 30 plots each year. The table gives the average results in yield of straw and grain per acre.

A mixture of two or more cereals has in every case had a favourable influence on the total yield, both of grain and straw. (One exception only is noted in the case of peas and wheat, where the yield of grain per acre was reduced. The mixture of barley and oats gave the highest production of grain and straw compared with the yields when grown separately.

Three sets of experiments each covering a period of 5 years have been in progress to identify the best proportions for use in combination: Twenty-five different proportions were tested. The greatest yield of grain per acre was produced by using a mixture of 1 bushel barley (48 lb.) and 1 bushel oats (34 lb.) per acre.

Practically no advantage has been observed with mixtures of different varieties of the same class of cereal. For instance, the growing of different varieties of winter wheat in combination for 5 years in succession, showed no advantage over growing the same varieties separately.

Other experiments were made with oats and barley; the highest yield

was obtained with the 6-rowed O. A. C. No. 21 barley grown in combination with the O. A. C. No. 3, with Alaska or Daubeney oats.

Yields of grain separately and in mixtures.

Varieties of grain grown in mixtures	Yield per acre			
	Straw		Grain	
	Grown separately	Grown in mixtures	Grown separately	Grown in mixtures
	(tons)	(tons)	(lb)	(lb)
1 Barley and oats	1.56	1.74	1 935	2 261
2. Barley, peas and oats	1.47	1.67	1 489	2 101
3. Barley, wheat and oats	1.47	1.72	1 683	2 067
4. Peas and oats	1.52	1.77	1 873	1 988
5. Barley, peas, wheat and oats	1.43	1.71	1 682	1 953
6 Wheat and oats	1.32	1.68	1 624	1 921
7 Peas, wheat and oats	1.44	1.73	1 642	1 860
8 Barley and peas	1.33	1.56	1 740	1 760
9. Barley, peas and wheat	1.32	1.57	1 553	1 665
10 Wheat and barley	1.30	1.41	1 491	1 558
11. Peas and wheat	1.29	1.37	1 429	1 322

The greatest influence on high yield has been caused by barley and next by oats.

Various lines of experimental work have indicated the advantageous effect of this combination on the yield.

L. V.

36 Correct Quantity of Lucerne and Clover Seed for Sowing Purposes.

BRESAOLA, M Sulla più conveniente quantità di seme necessaria alla formazione dei prati di medica e di trifoglio. *Stazioni sperimentali agrarie italiane*, Vol IV, Pts 10, 11, 12, pp 460-479. Modena, 1922.

Hitherto various writers have recommended different quantities of seed for the sowing of forage crops. In order to come to a more definite understanding as to the best rule to follow, the author carried out a series of tests in 1920-1922 on the experimental plots of the "Consorzio agrario" at Lodi, with sowings at the rate of 10 to 50 kg. per hectare for lucerne, and 10 to 44 kg. per hectare for clover. Lucerne gave the maximum yield (2442 quintals per hectare of dry lucerne in 14 cuttings in 3 years) when sown at the rate of 44 kg. per hectare; clover gave the maximum yield (1548 quintals per hectare for 8 cuttings in 3 years), when sown in the largest quantities; but doubtless the yield would have been higher if sown thicker. Probably it would be advisable to use a larger quantity of seed whenever possible.

F. D.

37. The Alexandrian Trefoil in Spain.

I. — AGUILO, I. El trébol alejandrino. *Boletín mensual de Olivicultura y Elaboración moderna del aceite de oliva*, No. 44, pp. 253-256. Tortosa, 1922.

II. — VILLAESCUSA, M. H. El trebol alejandrino en regadio. *Ibidem*, No. 46, pp. 272-273, 1922.

I. — The "Estación olivarera" in Tortosa of which the author is director, is conducting a campaign to encourage the introduction into Spain, as a rotation crop, the Alexandrian trefoil, a plant noted as a forage crop suitable for non-irrigated land, in addition to its value as a first class leguminous crop on irrigated territory, and suitable as green manure for wheat, olives and vines.

With this in view the Station proposes to distribute a small quantity of selected seed to farmers at a price only slightly above the net cost.

II. — The author reports the satisfactory results obtained on the Llobregat property with the Alexandrian trefoil, after irrigation. On the adjoining estate a $\frac{1}{2}$ hectare plot served to pasture 20 cows for 20 days in both April and July. Successful results have been obtained with this trefoil for silage purposes.

F. D.

38 The Manuring of Potatoes in Java.

VAN DER GOOT, P. De bemesting van aardappels op Java. *Teysmannia*, Year XXXIII, No. 9, pp. 401-411. Weltevreden, 1922

For the last ten years, potato cultivation in Java, has made satisfactory progress. It is limited to the cooler districts, that is to say to high altitudes. Dry, sandy soil is preferred and the red laterite has proved unsuitable. Manuring has been found necessary.

Manures employed. — No manure need be applied on newly cleared forest land for a few years. The natives then use farmyard manure at the rate of 150 *picol* per *bouw*, i. e. 9262.5 kg. per 0 70 965 ha.

The Europeans in the Lembang Tjisaroea district sometimes use a combination of chemical fertiliser and farmyard manure, at the rate of 180-200 *picols* (11 115 to 12 350 kg.) per *bouw* of the latter with 1 *picol* (61.75 kg.) of sulphate of ammonia, 1 *picol* of double superphosphate and 1 *picol* of potassium sulphate. Elsewhere similar methods are adopted (occasionally green manure is applied), but without exception, the manure is applied at planting time, and not some time after as in Europe.

Chemical fertilisers. — A mixture is on sale at present which has not been examined scientifically. The author has taken the opportunity of comparing the results obtained by using different fertilisers, during his investigations, on the disease caused by *Epilachna*. A white species was planted on March 23, 1922 and dug of June 9, 12, 14.

A comparison was made between plots with and without fertiliser :

- 1) Nitrogenous alone (sulphate of ammonia) ;
- 2) Nitrogenous + phosphate (sulphate of ammonia + superphosphate) ;

3) Nitrogenous + phosphate + potassium (sulphate of ammonia + superphosphate + potassium sulphate).

The following conclusions were drawn :

1) Anitrogenous fertiliser alone is insufficient for Lembang potatoes.
2) Phosphates give a high yield, and the proportion of small tubers (kriel) is less.

3) Potash had no effect on yield, and can therefore in future be disregarded.

D. V. S.

39. Selection of Fibre Flax in the United States.

I. — MILES, F. C. *Fiber Flax*. *United States Department of Agriculture, Farmer's Bulletin* 669, pp. 16, figs. 10. Washington, D. C., 1922 (revised),

II. — DAVIS, R. I. *Pedigreed Fiber Flax*. *U. S. Department of Agriculture, Bulletin No. 1092*, pp. 23, figs. 9, bibliography of works. Washington, D. C., 1922.

I. — The idea that it is impossible to produce a high grade of flax fibre without sacrificing seed has been disproved as a result of work carried out by the Office of Fiber Investigations, United States Department of Agriculture. It is true that the variety of flax commonly grown in the north-west for seed production will not under present methods, yield a fibre suitable for spinning purposes; the yield of seed from fibre flax is usually lower than that from flax grown primarily for seed. The quantity of seed produced, however, is sufficient to constitute an important by-product.

In all countries except Ireland where climatic conditions do not permit the seed to mature uniformly, the general practice is to save the seed. In Belgium, where the highest quality of fibre is produced, seed from the best types of flax is used for sowing and the remainder saved for feeding. In Russia seed is kept for sowing, and in addition large quantities are exported for the same purpose. In Holland the seed is not only saved but is highly prized for sowing.

According to the latest available statistics about 1 300 000 acres are under fibre flax each year as compared with more than 4 000 000 acres before 1914. The present production is about 190 000 tons of fibre as compared with about 800 000 tons in pre-war years. Russia which before the war produced about 80 % of the world's supply of flax, now produces less than half the quantity needed for its normal home consumption. During the years 1918 to 1921 the leading flax fibre producing countries were: Belgium, France, Ireland, Netherlands, Czecho-Slovakia and Japan. In the United States during these same years from 1000 to 6000 acres have been given up to fibre flax, and about 1 700 000 acres to seed flax.

In 1914 the world total of spindles was 3 034 101; — 1 161 874 in Great Britain and Ireland, 567 079 France, followed in order of sequence by Russia, Belgium, Austria-Hungary, Germany, Italy, Sweden, United States. Nearly one million spindles, or about $\frac{1}{3}$ of the total number are in Ireland, which imports about $\frac{3}{4}$ of the flax fibre used in the manufacture; France imports about $\frac{1}{5}$. Since 1914 there has been a marked

increase in the number of spindles in Japan, but since 1919, a decrease is shown in Great-Britain and Ireland. More than half the linens exported from Ireland are sent direct to the United States. The average annual imports amount to about 2 million dollars worth of fibre and about 20 million dollars worth of linen goods.

Several statements have been made to the effect that flax fibre of good quality could not be produced in the United States. Repeated trials in Minnesota, Wisconsin, Michigan etc. indicate however that soil and climatic conditions (humidity and relatively low temperature) in certain sections of the States are favorable for growing fibre flax, provided the proper cultural methods are adopted: autumn cultivation of the land; seed bed fine and compact; seed well cleaned and graded; sowing at the rate of about 6 pecks per acre and seed not covered more than $\frac{1}{2}$ inch deep; rotation every 7 or 8 years

Pulled flax is of greater fibre value than cut flax; the cost of pulling, however, sometimes counterbalances the advantage.

Certain flax-pulling machines have done good work on level fields when the flax was well-ripened but improvements are necessary for handling slightly immature flax, which is then at its best for fibre production

The average yield of fibre flax in the United States is about 2 tons of unthrashed straw per acre, from which 6 to 10 bushels of seed and 300 to 450 lb. of clean retted fibre may be obtained. In East Michigan a yield of 770 lb. has been recorded.

II. — Selection work with fibre flax was begun in the United States in 1909, with several thousand plants from the fields in Michigan, each of which was weighed and measured separately and fully nine-tenths were discarded; only the seeds from the heaviest plants were saved. The "centgener" tests were used (seeds from each plant sown in separate plots), and this work was continued up till 1914 in various districts, chiefly at Yale (Mich.), sown in drills. Uniformity of growth conditions was secured in 1918 by thinning out the rows to one plant per inch. In addition to the observations made as to height and weight of the plant, attention was given to the following characters: — strength of fibre per individual stem; vitality of seed. The author gives details of the resistance to disease and the special methods and apparatus in use for this purpose and the score card system of checking.

The method of selection now in use is based on a comparison by percentages of the various characters regarded as important and similar characters of the best strain used as a control. In a semi-commercial test the pure lines proved to be superior to commercial fibre flax.

The supply of seed of the pure lines has been increased by growing two crops in one year. Seed sown the first week of November near Fairhope (Alabama) matured in April, was thrashed the first week in May and resown in Michigan two weeks later. While normally an increase of only 6 to 25 times is expected with flax, by the above method the flax was increased 200 times.

Efforts are being made to combine the required characters of different strains by cross-pollination.

F. D.

40. The Height of the Hemp Plant.

CHIARAMONTE, A. La statura della canapa. Ricerche biometriche preliminari sulle variazioni dello sviluppo in altezza della canapa e sulle cause che vi influiscono. *Stazioni sperimentali agrarie italiane*, Vol. I, V, Pts. 10-11, and 12, pp. 421-433. Modena, 1922.

The author undertook the task of investigating the laws governing the variability in the height of the hemp-plant and the causes that influence it. He used for the purpose the biometric method and determined for each group, the type, average index of variability, coefficient of variability and probable errors.

The results are tabulated and summarised as follows.

1) The Carmagnola, Bologna and Ferrara strains may be regarded as sufficiently homogeneous types, since not only do they breed fairly true to type in the different generations and on various soils, but the frequency curves always have a single apex, showing that no marked mixture or segregation of characters is present.

2) These agricultural lines showed no signs of degeneration when propagated in Campania.

3) The Tekrouri hemp, like the common French and Anjou varieties, does not grow as high as the Italian hems, though Pelosella is quite equal to them from the agricultural standpoint.

4) The selection of seeds according to their various characters produces considerable differences in the height of the plants and in the variability of their characters, as well as the proportion of male and female plants which is probably due to unequal powers of resistance to environment on the part of the two sexes.

F. D.

41. Experiments in Jute Cultivation in S. Paolo (Brazil).

GUIMARSES, R. F. Cultura da juta en S. Paolo. *Secretaria da Agricultura Commercio e Obras publicas do Estado de S. Paolo*, Series 23th, No. 5 and 6, pp. 146-151. São Paolo, 1922.

The author, who under the direction of the "Secretaria da Agricultura dello Stato di San Paolo", has made investigations on jute cultivation (*Corchorus olitorius* and *C. capsularis*) grown by B. LESSA in the town of President Prudente, refers to the good results obtained especially with *C. capsularis* viz., height 4 m., 135 stems per sq. metre, 50 % fibre yield. These plants have been grown on land only recently cleared (formerly virgin forests) which is traversed by a water course, and is consequently very fertile. The seeds came from India.

The first attempts to cultivate jute in S. Paolo were made some twenty years ago. The Secretaria da Agricultura undertook the distribution of seeds and very satisfactory results were obtained in several districts, indicating the adaptability of jute to the change of climate. No definite footing was, however, made as for example in the case of wheat, but the Secretaria da Agricultura had distributed gratis some 10 000 quintals of wheat seed. The same method should according to the author, be adopted

with jute, which should be sold in the Brazilian market at a reasonable price, corresponding to the cost in the country from which imported, where the manual labour is exceptionally cheap. For this reason it is not advisable to substitute other crops of higher value or which require less attention such as coffee, manioc, maize.

F. D.

42 On Agave Varieties in Mexico.

PEREDO, E. Ligeros estudios sobre varios agaves. *La Revista agrícola*, Vol. VII, No. 3, pp. 267-268. San Jacinto, D. F., Mexico, 1922.

A comparison of 4 varieties of agave (*Agave mexicana*) from the same part of Mexico with the results of analyses set out in the following Table. The sap was extracted by means of a small press in the laboratory, and was thus collected in suitable, small quantities for practical industrial trials; heavy pressure has a tendency to harm the fibre quality.

The highest yield of fibre was obtained from the hennequin variety and the lowest from the maguey cenizo. The maguey Pitzometl which gave the maximum percentage of press residue or bagasse ("bagazo" possesses too short a fibre and has therefore no commercial value). The average theoretical yield of fibre, is about 15 % taking into account the losses in washing, drying, combing etc

Yield % of Mexican Agave varieties.

	Hennequin	Maguey cenizo	Maguey Pitzometl	Maguey cimarron
Sap.	43.5	43.5	37.0	56.0
Bagasse	56.5	56.5	63.0	44.0
<i>Bagasse content</i>				
Moisture	66.55	74.90	74.95	71.45
Dry matter	32.35	21.58	23.08	26.22
Ash	2.10	3.52	1.97	2.33
Estimated in dry matter	45.10	26.05	40.95	31.05
Average yield of fibre in leaves . .	13.20	5.57	8.70	7.66

The author gives also the results of an analysis of the sap of the 4 varieties: — density 1.0514 to 1.0680; extract of dry leaves 11.48 to 17.54 %; reducing sugars 1.89 to 2.63 %; non-reducing sugars 1.80 to 6.12 %; gum resin 3.30 to 7.62 %.

The hennequin contains the highest percentage of acid, dry matter, protein and sugar, and the lowest gum resin %; the gum resin is highest in the leaves of maguey cimarron (7.40 %) and maguey Pitzometl (7.62 %), in addition to their medicinal value.

F. D.

43. *Deguelia microphylla* (*Derris microphylla*) as Shade Plants on Tea Plantations in Java.

KENCHENIUS, A. *Deguelia microphylla* als schaduwboom en givenbemester in theeplantaties. *De Thee* (Korte aanteekeningen van het algemeen proefstation voor thee), Year III, No. 3, pp. 74-78. Batavia, 1922.

The trees used hitherto as shade plants on tea plantations in Java are: *Albizzia moluccana* ("djenng-djing"), *Erythrina lithosperma* ("dadap serep") and *Leucaena glauca* ("lamtor" or "kemlandingen").

The first two will grow up to height of 1500 m. almost independent of soil and climatic conditions. *L. glauca* on the contrary demands a fertile soil and grows best on the east of Java which is drier than the west, and development is inclined to be retarded above 1200 m. altitude.

The author makes observations as to the disadvantages of these trees. For instance, *L. glauca* does not thrive well on poor soil, *E. lithosperma* often decays at an early age and is also often attacked by various larvae, which results in loss of foliage at an early stage. *A. moluccana* is also attacked by larvae, especially the fully-developed trees. If the dead branches are not quickly taken away, infection is apt to spread to the roots; the wood is brittle, and consequently the trees are damaged by wind and the annual pruning and thinning out involves considerable expense.

The author recommends another tree as a suitable substitute for these three species, viz. *Deguelia microphylla*, which possesses several outstanding advantages when compared with the others, as the leaves may be used for manure purposes.

MLRSEN SENN VAN BASEL has grown this species for the last 7 years in his tea plantation (Pasir Karet) and is very well satisfied with the result.

The following advantages are given:

1) Thrives on the sea level and to heights of 1100 m. and probably even more, without showing any particular preference as regards type of soil.

2) As it is a leguminosa, the soil is improved from the biological, physiological and chemical standpoints.

3) Provides a serviceable shade during the whole year and does not require much pruning.

4) Grows fairly quickly, especially during the first years. On plantations below 1000 m. it is advised to cut back to 4.5 m. at the age of 3 to 5 years.

5) Serves as a useful windbreak; the wood is tough and in consequence the wind causes little damage.

6) Immune to larvae attack, and to root rot, and *Helopeltis* has not yet been found on it.

7) Forms many root-nodules.

8) Seed-bearing from 8 years of age onwards; good germinating capacity.

9) Gives a good fire wood and useful also for box making and for building purposes.

The author considers that *Deguelia* could be used to advantage to replace the trees used up till now, but as experiments have so far been very limited, it is recommended that planters make trials on their plantations.

D. V. S.

44. Coca Cultivation in Java.

PAERELS, J. J. Coca cultuur op Java. *Cultura*, Vol. XXXIV, No. 409, pp. 328-330. Utrecht, October 1922.

The coca cultivated for many years in Peru and Bolivia was introduced into Java in 1878. Two species are well-known, viz. *Erythroxylon coca* Lam. (in Peru), and *E. novogranatense* (in Java). The object has been to extract from the leaves certain alkaloids, useful in the preparation of cocaine. The plant is grown at 400-600 metres above sea level. A climate which is always moist is favourable to leaf development. It has been successfully grown as a catch crop between coffee or *Hevea*. After one year's growth a cutting may be made when the plants are 1 ft. high. If the bush reaches a height of 3 to 3 ½ ft. a cutting is made at 2 to 2 ½ ft.

The freshly picked leaves are spread out, to prevent fermentation, and then dried, in the air, by turning the leaves at intervals for one day, or else they are placed in a tea drying apparatus. The dried leaves are then crushed and ground, redried and packed. The green stems may be left as these also contain alkaloids. Tea cases, "kina" boxes or sacks are used for packing.

After 4 to 5 years, a plantation is in full bearing, and will continue for 20 years. Some 600 to 750 kg. of dried leaves is estimated per "bouw" (0.70965 ha.). The coca leaf is sold in the Amsterdam market per coca unit, i. e. the value % of alkaloids contained in a half kilogramme of leaves. The majority of the production is utilised in the Dutch and German factories. The amount sold per annum in Amsterdam varies from 265 000 to 910 000 kg.; the price per coca unit varies from 12 to 39 cents, and the alkaloid content from 1.45 to 1.64 %. At present a portion of the yield goes to America.

In Ceylon, Java coca is planted at an altitude of 650 metres, and Peru coca at 700 to 2500 m. The cocaine element is predominant in the Peru leaf, whilst cinnamyl-cocaine constitutes the alkaloid in the Java leaf. The latter however gives double the yield of alkaloid.

D. V. S.

45. Acclimatisation and possible Cultivation of the Tamarind in Mexico.

CANEDO, G. El hermoso y productivo tamarindo conviene cultivarse en Mexico. *Jalisco rural*, Year V, No 1, pp 770-782. Guadalajara, 1922.

The author has seen in the State of Jalisco at an altitude of some 1200 metres, a wild *Tamarindus indicus* species, which produces an abundance of fruit suitable for commercial purposes. This shows that this species is adaptable to Mexican climate conditions, and the author recommends its cultivation as it requires so little attention and yields well. F. D.

46. Correlation between Starch Reserves and Extraction of Rubber Latex.

SCHWEIZER, J. Over het verband aussken zetmeelvarraden en latex outtrekking bij Hevea (1), in *Archief voor de Rubbercultuur in Nederlandsch-Indië*, Year VI, No. 8, pp. 327-334. Buitenzorg, Aug. 1922.

The greatest importance should be attached to the understanding of the influence of tapping removal of bark etc. on the general functions of the plant. Tapping of *Hevea* causes a double reaction which does not exist under normal conditions.

After tapping, the latex must in some way be replaced and the bark renewed by means of reserve material, which in the case of *Hevea* is with starch.

The roots and aerial portions of the tree are responsible for plant nutriment, the former absorb the moisture and soluble inorganic salts, indispensable to the formation of organic material. It is therefore important that the root system be given every opportunity to attain its maximum growth, *i. e.* in a plantation the trees should be well spaced.

The aerial portion, by the aid of light and absorption of carbon dioxide from the atmosphere, both essential factors in the production of organic plant substances, especially sucrose, which is found in all parts of the plant in the allied form of starch. The trunk, the part between the roots and the branches takes part in the storage and transference of this material. What will be the effect of tapping on these two functions?

The author has limited his investigations to the study of starch, the chief reserve material. Under normal conditions the starch content varies widely; during the formation of new leaves the starch is transformed to sugar transmitted to the shoots.

RUTGERS has estimated that $\frac{1}{8}$ of the starch reserve is used for new leaf formation, and has therefore concluded that it is unnecessary to cease tapping at this stage, as there is still sufficient starch reserve. This conclusion would be accepted if it could be proved that the bark starch content possessed the same physiological value as the wood content. Practical experience has, however, contradicted this hypothesis and shows that the wood content is transferred only with difficulty. The bark content plays without doubt the more important part in plant development.

The author has made a series of tapping tests, noting in every case the bark starch content round the cut, and employing different methods of tapping and at different depths.

Several other investigators, as for example FITTINGS, SIMON, CAMPBELL have made similar tests, but contradictory results have been obtained. The latest opinion appears to be that tapping does not give rise to any distinct changes in the distribution of starch reserves.

The author considers that the variation in results obtained should be attributed to the condition of the trees. A tree growing on medium quality soil would naturally possess a less developed root system. On the

(1) See R. Dec. 1922, No. 1308. (Ed.)

other hand, when planted too closely, the shading is too much accentuated, which may hinder absorption of carbon dioxide from the atmosphere, responsible for the production of starch.

Under these circumstances the transmission of plant nutriment to certain parts, such as the tapping portion, is hindered, and consequently the reserves collected in the bark and wood are used up. This shows clearly the necessity for thinning out the trees from time to time, and the advisability of soil improvement, in order to maintain ideal conditions for *Hevea* cultivation.

The present modified systems of tapping, rendered necessary from the economic standpoint, only affects locally the starch reserves. But under less favourable circumstances, due to poor soil, closely planted trees and badly developed aerial portion the starch reserve of the trunk is considerably depleted, even when only tapped occasionally.

The amount of starch in the tapped area gives a good idea of the general condition of the plantation as well as the outcome of a certain system of tapping and in particular the individual capacity of the tree. D. V. S.

47. Latex and Rubber from Young Trees.

DE VRIES, O. Latex en rubber van jonge boomen. *Archief voor de Rubbercultuur in Nederlandsch Indië*, Year VI, No. 8, pp 296-309. Buitenzorg, Aug. 1922.

As the author has shown some years ago (*Archief*, I, 1917, page 175. See also "Estate Rubber, its Preparation, Properties and Testing" by Dr. O. DE VRIES 1920, p. 53) the age of the tree has less influence on the properties of the rubber than is often supposed. Older trees give a somewhat slower curing rubber with a high viscosity, but the quality in the more strict sense of the word (tensile strength and slope) does not show an improvement with age; and in trees of the ordinary tapping age of say 6-15 years the differences are very small.

This is not the case with very young trees, below what is usually considered to be the tappable age.

The author made a series of experiments on the latex and rubber of four groups of trees aged 3-14 ½ years, which gave the following results:

The rubber content of the latex was in two cases rather low, 20-25 %; in the other cases it was 25-30 %.

The specific gravity of the latex was about normal (as checked against rubber content) in two cases, but high in two cases, evidently caused by a higher concentration of serum substances than usual.

The rubber, especially in sheet form, showed very markedly the phenomenon of brittleness or "shortness", that is breaking easily when pulled by hand. This was not so evident in the crepes. The tensile strength of the rubber was very low, about 1.20 (and in one case even as low as about 1.00) for the very young trees; it was about 1.30 for somewhat older ones (figures for ordinary rubber 1.35 to 1.45). As the trees get older the repeat-experiments showed an increase in tensile strength.

The slope as a rule was about 38, that is higher (worse) than in ordinary rubber; with age the slope decreases (improves) somewhat.

These figures show clearly that rubber from 3 to 4 year old trees grown under rather adverse conditions (1 500 to 2 400 feet elevation) is of very poor quality.

The rate of cure was very high, the time of cure being 80 or even 60 minutes for crepe from 15 % latex (normal figure 110), and for smoked sheet even 50 or 40 minutes, that is nearly the time for matured rubber. As the trees grew older (from 3 to 4 years) the figure for time of curing did not yet show an approach to normal values.

The viscosity was very low, especially for crepe, figures, such as 10-20 being found (normal 30-35); for smoked sheet the figures were 20-25 or for somewhat older trees 35.

D. V. S.

48. Systems of Tapping.

VISCHER, W. in *Archief voor de Rubbercultuur in Nederlandsch Indië*, Year VI, No. 8, pp. 310-326. Buitenzorg, 1922.

It has not been possible up to the present time to come to a definite decision with regard to the selection of a tapping system. Experience gained during recent years has shown that the same method applied for some years may become disadvantageous at a later period, but it has not yet been shown what system should take the place of the former method in such a case. The system ought to be chosen so that: —

- 1) the latex withdrawn may be replaced by the tree and the yield may be well-sustained on the plantation.
- 2) the regrowth of bark on the old trees may be always proportionate to the loss of bark.
- 3) the loss of trees on account of disease etc., may be limited.

It is evident that each plantation has its own special conditions and that a system could not be chosen which would be suitable for all plantations; the nature of the soil, for instance, is of great importance; on poor land it would be necessary to employ a moderate system of tapping. Experiments on the matter have recently been made on a number of estates, and the results have been sent to the experimental station for rubber A. V. R. O. S. The author gives details of 4 different systems:

- 1) Tapping on alternate days.
- 2) Tapping every three days (two days rest).
- 3) Tapping with longer resting intervals (15 days, 1 month, 2 months).
- 4) Tapping every two days and every two months. During the first year the yield under the daily tapping method, as compared with system 1 is as 100 : 60. Little by little the yield increases, until in the third year it exceeds that of the former method.

For the 2nd system the ratio was as 84 : 100 for the first year. ,

Example of 3rd system :

		$\frac{1}{2}$ circumference tapping 15 days resting 15 days	$\frac{1}{2}$ circumference tapping daily
1st and 2nd months		70 %	100 %
3rd " 4th "		72	100
5th " 6th "		75	100
7th " 8th "		70	100
9th " 10th "		65	100

This method is thus more advantageous than the first. Compare also GIRARD's results (this *Review*, Jan. 1921, No. 54 and Jan. 1922, No. 51).

$\frac{1}{2}$ circumference every two months or every two days 100.

$\frac{1}{2}$ circumference tapping daily 100.

The older trees recover less rapidly. The experiments are being continued but so far, the author has compared only the *yields* of the systems; it is necessary also to take into account the influence of the system of tapping on the general condition of the trees, for instance, with regard to the replacement of the bark.

It can be said that on plantations where the alternative method has been in use for 5 or 6 years, the growth of the trees and the replacement of bark has been quite satisfactory. It has been found also that the alternate system lessens diseases of the inner bark. The rubber content of the latex is distinctly higher. In the case of a plantation which is already mature, before the adoption of the alternate tapping system the trees should be given the opportunity for thorough restoration. As regards the system of tapping to be employed in the future, the author considers that the following systems should be compared without delay :

$\frac{1}{2}$ circumference				$\frac{1}{2}$ circumference			
1 day rest,	1 day	tapping		1 day rest,	1 day	tapping	
1 " " 2 days	"	"		2 days " 1 day	"	"	
1 month " 1 month	"	"		1 month " 1 month	"	"	
1 " " 2 months	"	"		2 months " 1 month	"	"	

The results of these experiments would be valuable after a few years.

The rubber experiment station (West Java Rubberproefst) has put forward a series of questions to the planters of Java, with this end in view.

- 1) What systems are (or have been) in use on your plantation ?
- 2) Have trials already been made with incisions of a stated length ($\frac{1}{4}$, $\frac{1}{3}$, $\frac{1}{2}$, of the circumference) with resting periods, every two days, every three days, every two months etc., or with a resting period of several month in the year, and if so, with what results ?
- 3) Which tapping system do you prefer and on what data do you base your preference
- 4) At what age, with regard to the girth of the trunk do you begin tapping on your plantation, and which age do you prefer ?
- 5) Would it be possible to make tapping experiments of this nature on your plantation ?

6) General considerations: influence of tapping systems on market price, diseases etc.

Replies to these questions will be published.

D. V. S.

Horticulture.

49 Vegetable Varieties recommended by the German Agricultural Society.

WEIRUP (Garteninspekter, Hildesheim). Sortenwahl beim Gemüsebau. *Mitteilungen der deutschen Landwirtschafts-Gesellschaft*, Year XXXVII, Pts. 52, pp 763-764 Berlin, 1922.

As a result of experiments carried out by the "Sonderausschuss für Feldgemüsebau" (Market Gardening Special Commission) under the direction of the Deutsche Landwirtschafts-Gesellschaft, the author recommends the following varieties:—

PEAS: (See W. SCHULTZ Vierjährige Erbsen-Schoten. Versuche von 1909-1912. Arbeiten der D. L. G. Heft 253); Verbesserte Schnabel; Buchsbaumschnabel, Grünbleibende Folger; Express; Monopol; Morinia weiss (Teutonia); Moringia grün.

BEANS: 1) Dwarf kidney: Saxa, Hinrichs Riesen-Thuringia; 2) Climbing kidney; Phänomen Otto weddigen; Meisterstück; Shell beans, Riesen-Sabel Wachs; Ideal; Wachs; Amstrat Koch.

CARROTS. Pate: Lange; Rote Sudenburger; Verbesserte Nantaise; early, Pariser Markt; Frankfurter Treib.

CABBAGES — early spring: — Früher Dithmarscher, Ruhm von Enkhuizen; Früher under Glückstädter; late: — Grosser runder Magdeburger; Grosser später Hellander, keeping quality: — Amager, Coleworts. Westfalia, Vertus Später Dithmarscher.

ONIONS.: Zittauer hellgelbe; Blutrote Zittauer Riesen. The red varieties are more resistant than the yellow.

F. D.

50 Cultivation of Artichokes in Algeria.

FOURNIER (Chef de la station de la Ferme-Blanche, Oran). Culture de l'artichaut en Algérie. *Revue agricole de l'Afrique du Nord*, Year 20, Nos. 171 and 172, pp. 717-719, and 736-738. Algiers, 1922.

The author gives an interesting account of the present position of intensive cultivation of the artichoke in the neighbourhood of Perregaux. The most common varieties are: the "quarantain" which resembles the green Provence variety; the violet artichoke, and the Roman artichoke. Details are given as to the planting, cultural operations, digging up, crop yield, transport, costs of cultivation, diseases and pests and the net returns.

Reference is made to an article by Dr. TRABUT (Maladie des artichauts), appearing in the *Bulletin agricole de l'Algérie et de la Tunisie* P. C.

51. On Chayote (*Sechium edule*) in Japan.

TANAKA, T. Okinawa Prefectural Agricultural Experiment Station (Okinawa Kenntsu Nô Shikenjô. "Chayote in tsukite"). *Journal of the Agricultural Society, Japan*, No. 492, Vol. II, Pt. III, pp. 33-37, figs. 3. March 1922 (Japanese).

Chayote (*Sechium edule*), a new cucurbitaceous crop to Japan, was first introduced from America into Kagoshima prefecture in 1917 and since then it has spread rapidly all over the south western parts of the Island Empire, on account of its valuable fruit characters and its facility of cultivation. In Okinawa prefecture, two crops a year are obtainable and about 3000 fruits weighing 620 gm. per fruit are produced per are (1 are = 107.6 sq. ft.) It is easily propagated by cuttings or division during the month of December and about 10 plants per are, are set out, the vines from which are usually trained upon a horizontal trellis. The fruits are eaten raw or seasoned, cooked, preserved and pickled, and the raw fruits can be shipped for a low distance. No serious disease or insect pest has been observed. It is therefore recommended as a profitable crop for temperate regions, where there is no frost until the middle of November.

T. T.

52. Factors influencing the Profitable Production of Tomatoes for the Early Market and Canning Factory, and Cost of Production.

JONES, H. A. *University of Maryland Agricultural Experiment Station, Bulletin* No. 248, pp. 153-186, tables XIII, bibliography. College Park (M. D.), 1922.

The purpose of this bulletin is to place before the grower the best methods to adopt to obtain maximum yields of superior quality tomatoes. Experiments have been in progress at the University of Maryland Agricultural Experiment Station (U. S.) which if put into common practice should result in a big increase in total production.

Interesting details are given as to the selection of seed, comparison between methods, yield per acre etc. of transplanted and seed-bed plants.

The method recommended for growing canning tomatoes is the hot bed cold frame system. Sowings are made in hot beds and the seedlings are transplanted after 2 weeks and finally set out 6 weeks later. A description is given of the field cultivation including a list of diseases and pests and the best methods of prevention and control.

An investigation as to the cost of tomato production was started in Maryland a few years ago, and a comparison of the records kept on various farms is shown.

M. L. Y.

Vine growing.

53. Growing the Crops of Temperate Climates and especially Vines, in a Tropical Country.

BERGET, A. La viticulture tropicale d'après l'expérience de la Réunion. *Revue de Viticulture*, Year 29, Vol. LVI, No. 1436, pp. 5-16; No. 1437, pp. 29-

33 ; No. 1438, pp. 41-44 ; No. 1439, pp. 61-64 ; No. 1445, pp. 181-184 ; No. 1447, pp. 226-232 ; Vol. LVII, No. 1463, pp. 21-26 ; No. 1467 pp. 85-90 ; No. 1472, pp. 165-170. Paris, 1922.

The island of Reunion forms an ideal experiment ground for investigation respecting the acclimatisation in a tropical country of plants from temperate zones, for although its area is only some 2500 km², it includes a series of successive climates suited to different forms of vegetation.

On the lower levels are plains with a very variable rainfall, ranging from 3.50 m. on the southern side exposed to the trade-winds, to 0.20 m. on the north-west side, and in consequence the vegetation passes from tropical luxuriance to almost desert sterility.

Above these plains rise magnificent coombes overlooked by lofty mountains, one of which, Piton de la Neige, reaches the height of 3069 m.

Thus, there are : 1) a *torrid zone* in the coast plains where sugar-cane, manioc etc. grow ; 2) a *warm temperate zone* at between 400 and 800 metres in the part exposed to the wind, and at between 600 and 1200 m. on the leeward side. In the former, are found woods of tree-ferns ("faujans"), palms and *Acacia heterophylla*, while in the latter, the olive, vine and mulberry thrive, as well as most of the plants of the temperate zones, and especially those growing in the Mediterranean region ; 3) a *cold temperate zone* with low shrubby growth and pastures at altitudes between 1200 and 1800 m. ; 4) a *cold barren zone* where there is frost at the higher altitudes during 5 or 6 months of the year.

The coastal area is not suited to white men who contract malaria as soon as they attempt to till the soil themselves, instead of merely supervising the work of the natives, or of Hindu immigrants. The temperate zone, from 500 m. in altitude, is on the other hand, perfectly healthy and well-suited for the acclimatisation of the white race, as is shown by the existence of a race of white workers of somewhat mixed blood, the so-called "little whites", who have small holdings and live by cultivating the land.

The introduction of the crops of temperate climates would thus be of considerable social importance, inasmuch as it would improve the conditions of this race and open up another field for colonisation.

The highlands of Réunion, especially those protected from the wind (from 200 to 600 m.) were at one time under coffee, which could perhaps grow to a height of 1000 m., but on the introduction of *Hemileia vastatrix* from Ceylon in 1869, coffee-growing was almost entirely abandoned, although this measure was quite unnecessary, since the Uredinea can easily be controlled by the application of sulphate, as has been proved by some of the large land owners of the island who have not only saved, but extended, their coffee-plantations.

An attempt has been made to introduce resistant African varieties of coffee from Liberia, Koullon and the Congo, the products obtained were, however, very inferior. Hybrids between resistant varieties and the native coffee (*C. Mauritiana*) seem likely to prove more satisfactory.

The returns formerly obtained by coffee cannot be replaced by the sugar-cane, for the yield of this plant decreases as the altitude increases.

For this reason, various new crops were tried: the Isabelle variety of wine was grown but afterwards given up on account of the foxy flavour of its grapes. Silkworm breeding was started, in order to use the black mulberry trees that grow almost everywhere in the island; this industry however did not succeed, as the "seed" used was infected with pebrine. Citrus fruits were cultivated, but the attacks of coccids destroyed the crops. Potatoes which at one time propagated themselves on the island, have now become more difficult to grow than in Europe, owing to the attacks of *Phytophthora*. Some varieties tested by the author such as *Géante bleue*, Prof. MAERCKER, *Marjolin* and *Géante blanche*, have given good results. Artichokes, lentils and beans are cultivated in considerable quantities at Dos d'Ane, Cilaos and Salazie. The geranium used for distillation grows only between 800 and 1 000 m. and on deforested land, and is a cause of serious injury to the forest and cultivated ground. The "chouchoute" or "chayette" (*Sechium edule*), like the geranium, was introduced from Algeria about 20 years ago. The chief article of food in this area is maize, which takes the place of the imported rice chiefly eaten in the coastal districts. At one time, wheat also was cultivated in Reunion, but the level tracts suitable for wheat-growing were not sufficiently extensive.

The European peach-tree has become well-acclimatised, but is so much attacked by the fruit-fly, that the peaches have to be picked before they are ripe, and used for preserves. The author has tried to remove this difficulty in two ways; by the use of arsenical sprays at the flowering season, and by growing American peaches and one of their hybrids, Gaillard-Girerd, which flowers earlier, and therefore probably before the fly deposits its eggs.

A plum similar to the Japanese variety grows wild in the island. The author has planted and grown successfully, a collection of French plum-trees with the intention of grafting them on the native variety.

Negative results were obtained from the cultivation tests of French cherry-trees, but there is already in Réunion a Brazilian variety with persistent leaves.

Dessert-apples are grown on the Plaine des Palmistes, and cider-apples at Grand Ilet-Salazie; better results are however obtained from pears, although the trees are attacked by a bud-destroying insect similar to *Otorhynchus*.

In order to maintain their yield, all these fruit-trees require thorough pruning and thinning; the author advises rearing low-growing trees.

The problem of finding field crops for the healthy zone inhabited by the white race therefore remains for the most part unsolved. The author considers that three plants should be tried especially, the mulberry-tree (white mulberry grafted on the black variety already common in the island), the olive (the native production of oil supplied by the ground-nut or "pistache" is wholly insufficient), and the vine.

Silk-worm rearing would have the most rapid success, for raw silk in constantly increasing quantities is always being imported by France. The black, white and yellow wild olive-tree is frequently met with in the

forests and coppices of the island and when it is decided which European variety it would be well to acclimatise, grafts could be made on the already-existing olive-trees.

The vine could be planted at the limit of the coffee zone, lower down than the belt of the dwarf bamboo ("calumets"), viz. below 1000 m. In this area, the temperature falls at night below 10° C for 2 or 3 months and would give the vine a rest-period, which is necessary to prevent it bearing fruit and flowers twice a year and occasionally at the same time, in which case, the berries fall off or ripen irregularly, or incompletely, so that the grapes can at most be used for table-fruit and are useless for wine-making.

The author mentions the various attempts at vine-growing in tropical countries made by the Department of Agriculture of the United States in Georgia and Mississippi, by Dr BARRETTO, in the State of San Paulo (Brazil) (1); by the German Authorities on the plateaux of former German West Africa, where, at the Station of Kvai, Usambara, over 400 000 vines were planted and included many American varieties from Texas; by the French Government in Laos, Madagascar and Réunion; etc. He also mentions several hot countries where the wild, or cultivated, vines bear grapes.

If vine-growing is at present limited in Réunion to a few small vineyards, which chiefly produce table-grapes, this is not because the vine does not succeed well in the island and yield large profits, but is attributable to the fact that at the beginning of colonisation and for a long time after, the French Government forbade the cultivation of vines and olives, except for family use, in all the tropical colonies (Antilles, Réunion and Mascarene Isles) for fear of competition with the mother-country.

The author states that "tropical vine-growing can only be an exceptional industry, limited to certain localities and to special vines." The object of his experiments was the systematic identification of the particular vines suited to the island of Réunion.

During his stay there as Chef de Service de l'Instruction publique, he planted small experimental vineyards on the coast, at Saint Denis, at an altitude of about 600 m. (Convalescence de Saint François), near Hellbourg (850 m.), and at Cilaos (1100 m.).

The vines tested came from France and Tunisia and were sixty in number.

The ill-will shown by the local authorities prevented the author from concluding his work so he was only able to obtain a few bunches from the most vigorous vines, but the observations he succeeded in making allow him to reach the following conclusions:

1) *Technical conditions of tropical vine-growing.* — The zone of vine cultivation begins in tropical countries on the extreme upper limits of the coffee plantations and extends to between 600 and 1000 m., provided the annual rainfall does not exceed 1.20 m.

The cultural operations required must be ascertained experimentally,

(1) See R. 1921, No. 301. (Ed.)

for the methods used in temperate climates cannot be adopted in the tropics.

2) *Planting and propagation.* — The ground must be prepared by deep ploughing, and the cuttings should not be planted too near the surface, or a large number of young shoots will be formed; the space left should be ample owing to the strong growth made by most vines. Pruning for long canes suitable for pergolas etc. is to be recommended. Green pruning is of the greatest importance.

3) *Choice of vines.* — Vines ripening early should be chosen by preference, as these escape anthracnosis, oidium, and injury from cyclones; further, the grapes are ready for gathering before February-March which is the worst time in the tropics. The Chasselas variety does well in Réunion where it sometimes bears enormous bunches. Grenache de Roussillon and Cinsaut de Provence also give excellent results from the coast up to an altitude of 500 m. Other varieties that have shown themselves very promising are: Clinton, Croton, Noé, and the direct bearers Couderc 7120, Seibel 1077, and Gaillard No. 2; perhaps hybrids are specially suited to tropical countries. Early American vines with thick-skinned grapes such as Isabella, do better in hot countries than European varieties, but their fruit is very inferior.

Good results could probably be produced from the hybrids of *Vitis rotundifolia* and *V. Munsonia* obtained in the United States (1) as well as from some species of *Ampelocissus* (vines with caducous leaves, annual vegetation and reserve tubercles), of African types such as the "Sudan vine" which grows throughout tropical Africa especially in Uganda, or the wild Asiatic variety of Yunnan which buds extremely early.

One specimen of *Ampelocissus*, most likely from the Sudan, bore edible grapes, that could also be used for wine-making, in the Saint Denis Botanic Gardens. The cultural value of the Asiatic *Ampelocissus* still remains to be decided.

Collections for study are necessary for the proper choice of vines, while the oenological value of the different varieties can only be found by local experiments and by following the fermentation methods adopted in Tunisia and Algeria.

4) *Adverse circumstances.* — There is little to be feared from hail or frost, but cyclones are much to be dreaded, as they strip all the leaves and grapes from the vines. It would therefore be wise to grow the vines in such a way that they could be laid down on the ground at times when cyclones are probable, thus a hinged support might be used which could be kept horizontal during the bad season, and placed upright for the rest of the year.

Anthraco-sis and oidium are more serious diseases in Europe. The gravity of oidium seems to depend upon the degree of insolation. Peronospora on the other hand is by no means formidable, it exists to a slight extent, but the diseased spots do not spread even in the rainy season, although no preventive sprays are ever used in Réunion.

F D

(1) See R. 1917, No 1015 (Ed)

54. The Absorption of Fertilising Material by the Vine at different Periods of its Growth.

LAGATU, H. (Report presented to the Regional Agricultural Congress of South-West Toulouse, May, 1922) *Progrès agricole et viticole*, Year 39, Vol I, XXVIII, No 36, pp 226-238, Tables 3, Plates 3. Montpellier, 1922.

The author has made a study of a vine plant growing under conditions of intensive culture, in a favourable climate and secured against any accidental occurrence apart from those connected with its mineral nutrition. As plant building-material, only nitrogen, phosphoric acid, potash, magnesia and lime are taken into account.

The following questions are put forward : What nutritive materials ought to be included in the fertiliser formula ?

What form should each of these materials take ?

What should be the relative quantities of these materials ? What quantities ought to be applied per hectare and per year ?

In what way should the manure be incorporated with the soil ?

The author recalls the requirements of the vine and the changes that are shown at different periods of its growth. Then taking into account only potash, magnesia and lime an attempt is made to ascertain how many, out of 100 mono-basic valencies may be attributed respectively to potash, magnesia and lime. These three bases can chemically replace each other, in accordance with their equivalent weights and the plant selects the one most suited to its requirements at any particular time. These results are given in diagrammatic form and show that the system of nutrition of the vine, is variable as regards the basic materials, for each organ and for the entire vine-stock.

The lime-alkalinity is absorbed by the whole vine-stock, at first slowly, less quickly than the potash-alkalinity and a little more quickly than the magnesia alkalinity.

Apart from the florescence the rate of absorption of the lime-alkalinity is much greater than that of the other bases. It declines when hardly any more new leaves are produced. The rate of absorption of the potash-alkalinity which is sufficient for flowering period to the early part of July becomes nil at the time when the grape changes colour in order to be available during the last fortnight of growth. Some important, practical conclusions may be drawn from these results, above all as regards potash. The leaves may give up this base in favour of the grapes, but when the supply is limited and none can be obtained from the soil, wilting is caused and often premature browning.

The author, in the continuation of his work on nitrogen and phosphoric acid, concluded that the vine in proportion as it grows has less need of nitrogen in relation to phosphoric acid, but it is still important.

The manure ought thus to maintain a constant supply of available nitrogenous food material, *e. g.* as nitrates, ammonium salts and blood manure combined in such a form as to be slowly nitrifiable. Phosphoric acid, *e. g.* as superphosphate, ought to be dominant in the early stages of growth. As regards the application of fertiliser, it is recommended that

it should not be scattered too widely, but should be put within the area of root-activity, also, that the surface layers of the soil and the vine-trunk should be avoided.

P. C.

55. American Vine Stocks.

RAVAZ, L. and VERGE, G. Nouvelles recherches sur les porte-greffes. *Annales de l'Ecole Nationale d'Agriculture de Montpellier*, New Series, Vol. XVII, Pt. III, pp. 227-241. Montpellier, 1922.

Experiments covering a period of 20 years, sufficient time to permit direct observations of the characteristics of the vine stocks to be made.

The authors discuss briefly the following vine stocks: Riparia, Rupestris, Berlandieri, Vitis Monticola, V. cordifolia, V. candicans, V. cinerea, Riparia-Rupestris, Riparia-Berlandieri, Vinifera-Rupestris-Berlandieri, Berlandieri-Vinifera, Riparia-Monticola, Vinifera-Rupestris. Several tables are included. It is stated that the soil in the experimental fields contains 18 to 38 % of carbonate of lime and does not assist resistance to chlorosis. The authors consider that the good qualities of the most popular stocks at the present time-viz. Riparia, Rupestris, Riparia-Rupestris, Riparia-Berlandieri, Rupestris-Berlandieri and Vinifera-Berlandieri (41 B 333. etc.) are undesirable. Vinifera-Rupestris is liable to die off. These experiments draw attention to 17-37, but this, however, is not adaptable to budding; also 150-15 Malègue.

P. C.

Forestry.

56. *Pinus Peuce* Grisebach: Forestry Monograph.

DIMITROFF TH. (Forestry Inspector, Professor of Sylviculture at the Government Technical College and at the Forestry College of Sofia, Bulgaria), *Pinus Peuce* Griseb. pp. 43, Sofia 1922.

The author has devoted himself to the study and determination of the botanical and forestry characters of *Pinus Peuce*. The chief habitat of this tree is Bulgaria; it is exclusively a Balkan species and has hitherto never been described in European forestry literature; nor has it been studied to any extent from the botanical standpoint.

The monograph is divided into 14 chapters.

Chapter I (General observations) contain some historical notes chiefly taken from the following works: A. GRISEBACK "Reise durch Rumelien und nach Brussa im Jahre 1839" and JOSEF PANCIC, "Elemente der Flora des Fürstentum Bulgarien." As regards the popular name of this tree, it is interesting to notice that in contradiction to its botanical name, this pine is known in Bulgaria as "bjala mura", or the "white pine", while *P. leucodermis* Antoine is called "tschernna mura", viz., the black pine.

Chapter II (Growth and Habit) gives the dimensions attained by this tree in the forests on the mountains of Rila, Rodopi, Pirin and Witoscha. The data have been taken from the reports of some forestry estates in

these mountains. It appears, that *P. Peuce* grows to a large size in Bulgaria and attains the dimensions of the other conifers: spruces, firs and pines.

Chapter III (Root system, and Form of the Roots): attention is here drawn to the deep and vigorous root-system of this tree which is very resistant to wind.

Chapter IV (Needles and Leaf-Development) contains a detailed comparative description of the needles of *P. Peuce*, *P. Strobus*, and *P. Cembra*; their position, size, colour etc., being taken into consideration. A description is also given of the buds, their size, shape etc.

In Chapter V (Cortex) are given the characters of the bark, both when old and young. The breaking away of the old cortex, and the appearance of the new at different ages, being especially described.

Chapter IV (Fructification, Cones, Seeds and Germination) is a most exhaustive account. *P. Peuce* is compared with other pines as regards date of flowering, the development of the cones and seeds, their shape, size, appearance etc. Information is also given as to the collecting of the seeds in the establishments where the cones are dried. Details of the planting and raising of this species for afforestation are also supplied.

Chapter VII (Requirements as regards Light). In this respect, the author places *P. Peuce* between *P. Strobus* and *P. Cembra*, as it is less affected by shade than the common pine, but requires more light-loving than the spruce.

In Chapter VIII (Area of Diffusion) the author gives the geographical diffusion of *P. Peuce* and shows that it grows exclusively in the Balkan countries, where it helps to form some of the high mountain forests of Bulgaria, Macedonia, the former Serbia, and Montenegro. He gives almost all the localities where this tree grows in the mountains of Rila, Rhodopi, Pirin, Witoscha, and Stara-Planina, together with the various altitudes at which it occurs in Bulgaria and its highest and lowest limits.

In Chapter IX (Exposure) are mentioned the aspects of the districts preferred by *P. Peuce* which show that these trees thrive in situations facing North-East and North-West.

In Chapter X (Soil Requirements) it is stated that *P. Peuce* is not absolutely calciphobe, as has hitherto been supposed. According to Prof. N. KOSCHANIN (Belgrade), KARL MALY (Sarayevo) and N. STOJANOFF (Sofia) this tree grows well on calcareous soils also where it forms part of the stands in some of the forests.

In Chapter X (Climatic Requirements) the author shows that *P. Peuce* thrives in Bulgaria in the mountainous region; where the climate is suitable for *Picea*, at altitudes not below 1200 m. and not above 2500 m., where rain falls an almost half of the days of the year; the average rainfall is 600-1500 mm., and the vegetative period lasts 4 months.

Chapter XII (Timber) is divided into two parts: a) the properties of the wood, b) the uses of the wood.

The wood of *P. Peuce* is especially characterised by lightness and homogeneity; in regard to the first of these qualities, it much resembles the wood of *P. Strobus*, while in structure, it is very similar to the wood

of *P. Cembra*; it is more durable and of better quality generally than the timber of the other forest conifers of Bulgaria. As *P. Peuce* grows to a large size, it supplies excellent building timber.

In Chapter XIII (Behaviour Under Adverse Conditions) emphasis is laid on the fact that this conifer whether growing wild, or cultivated, has proved particularly resistant to adverse meteorological conditions, as well as to the attacks of various insects and cryptogamic parasites. Amongst its few enemies, the author has found only two insects: *Cripturgus cinereus* Hbst and a Buprestid. The tree is however, attacked by two parasitic fungi: *Trametes radiciperda* R. Hartig and *Agaricus* (*Armillaria*) *melleus* Fur. Dan.

Chapter XIV (Deductions and Conclusions) is divided into two parts: the Supervision and Formation of the Forest

The fact that the number of *P. Peuce* is continually decreasing in the woods of Bulgaria is explained by the author as follows. This tree is exclusively a denizen of the high mountains and grows in a cold climate where it is exposed to the severe competition of other conifers, while it, at the same time, has special requirements as regards the chemical and physical composition of the soil. Its seeds, like those of *Pinus Cembra*, remain in the ground a whole year before germinating, and are thus exposed to the attacks of rodents, birds etc. The author therefore advises the prompt adoption of certain measures for the protection of these valuable woods.

The author draws attention to the small number of stands of which *P. Peuce* forms even a small part. At different times, and in various places, Bulgarian sylviculturists have tried to grow this species, but with little success, owing to their insufficient knowledge of its characteristics as a forest tree, and especially of its requirements in the matters of climate and soil.

D. T.

57. The Cedar of Lebanon in Provence.

DE BRUN, H. Le cedre au Mont-Ventoux et en Provence. *Revue des Eaux et Forêts*, No 8, pp 249-256. Paris, 1922

Mont Ventoux in the pre-Alpine region of Provence has become from the forestry standpoint an ideal field of experiment and observation, on account of the rapid successions of its plant zones. And the reforestation that has been in progress there for over sixty years

The author emphasises the importance of this work, especially as regards the cedar of Lebanon, a tree which hitherto has not been sufficiently appreciated.

There is no public park that does not boast some specimens of this ornamental tree, but actual forests are somewhat rare, and amongst these, few equal in size the forest of Mauvallat, in the Bedoni commune, situated at an altitude of about 800 m. on the southern slope of Mont Ventoux. This forest occupies some 150 hectares and is composed of pines (75 %) and cedars of Lebanon (25 %) which though smaller in number, dominate the pines, their tapering forms towering over the neighbouring trees.

Reafforestation was carried on between 1863 and 1869, the pines and cedars being sown and planted simultaneously. At first, the pines predominated, but gradually the cedars asserted themselves and as during thinning operations, they were spared in preference to the pines, their numerical superiority gradually increased. The future expansion of the area under cedar is further assured by the great facility of seed dispersion to almost incredible distances, so that the clearings far and near are full of promising and luxuriant young growth, as quoted by DE BRUN, explaining the Biblical simile: *sicut cedrus Libani multiplicabitur*.

While the pine (both the black and maritime varieties) is 0.90 to 1 m. in girth and 13 to 15 m. in height (at the level of a man's chest from the ground), the diameter of the cedar ranges from 1.20 to 1.50 m. and the height varies from 16 to 18 m. The typical shape is pyramidal, except when the density of the forest hinders the natural growth, and causes its form to tend towards cylindrical. The cedar wood is resinous and fragrant; its duramen is rather dark. The wood is said to be heavy, full of knots, and non-resistant to flexion, but all these defects are remedied by ripening, and the resistance to pressure increases with the decrease in the knots. It is very durable and for this reason is preferred already to pine-wood by traders; doubtless, when this quality is more widely known, the use will be considerably extended.

The cedar has the great advantage from the forestry standpoint of being rarely attacked by the larvae of *Bombyx processionalis*, which is often so injurious to other trees employed in reafforestation; in addition to this there is less fear from fire, as the soil is damper than with pines, also the cedar provides a better covering for the ground. A good deal of profit has been obtained from the thinning debris, and owing to the capacity of asserting itself, the cedar will gradually invade the thin coppices in the neighbourhood. There is, however, reason to fear that as the trees are used too quickly, before they have become fully mature they are felled before they have reached the most profitable size.

The author then passes on to consider the area for the propagation of the cedar in pre-Alpine reafforestation, and the question of sowing. Other forests similar to those at Bedoni are also to be found in the district Avignon, especially in the mountains of Vaucluse and the Luberon chain. At Bedoni the cedars are found on the limestone of M. Ventoux, at altitudes ranging from 650 to 1000 m., but at Vaucluse on the southern slopes at altitudes of only 300 m. (very low for such a distinctly mountain species), and showing no preference for any particular exposure, while at Luberon where the soil is almost the same but the latitude is lower, with a typical provençal climate, cedars can only be acclimatised on the northern declivities and at heights varying from 500-700 m. On the southern slopes, a few isolated trees are to be found, the survivors of seed sown at the same time as the Bedoni, from 1860 to 1869. This zone, however, has many promising specimens of *Abies pinsapo* and *A. laricio* (Corsican larch, while $\frac{2}{3}$ of the lower slopes are covered with natural Aleppo pine forests.

If by the acclimatisation area is understood the area on which natural and plentiful reproduction occurs, and where the wood undergoes no

change, but retains the native characteristics, the acclimatisation area of the cedar may be considered to be situated above the natural zone of the Aleppo pine, and the lower limit to approach the often ill-defined zone of *Quercus ilex* and *Q. pubescens*. The upper limit of the cedar extends, where the exposure is good, above that of the maritime pine, as owing to its shape, it has less to fear from snow than the latter, although equally susceptible when young to hard frost.

The cedar is not exacting as to the mineral composition of the soil, provided that the earth is deep and permeable enough to admit of the long, strong roots penetrating to a great depth.

In its native habitat, this tree grows at an altitude of 1400 m., and although the latitude of Lebanon, the Taurus and still more that of the African Atlas Mts. is much lower than that of southern France. LE BRUN is of the opinion that the cedar could be acclimatised there at 1000 m. or above, if care were taken to protect the young plantations from severe frosts. This is immediately followed by an inquiry as to why, since 1870 the cedar has never been used in reafforestation in France, for he does not accept DEMONTZEY's explanation that this tree should not be planted on denuded ground, since the latter is not common; neither does he share the dislike expressed for seeds and preference for plantations as giving more regular results. The cedar possesses as is well known, a very large tap-root and is therefore unsuited to transplanting; perhaps this last difficulty may account for DEMONTZEY's aversion but it should be remembered that even he did not absolutely prescribe its use. The author attributes the neglect into which it has fallen to the difficulty of preserving the seeds, as they are not able to withstand the long storage at first recommended.

In 1914, however, as a consequence of the good results obtained at Bedoni, the problems of collecting and storage of cedar seeds were again studied, and a storehouse was built near the forest. The cones were gathered as soon as ripe, that is to say about September or October, and kept intact in the storehouse until the spring, unless any seeds were required for immediate sowing. CHAUCRY recommends that the cones be left uncollected until the first scales near the base begin to fall off; this takes place at different dates according to the season and the individual cone.

The seeds are easily extracted if the cones are first softened by remaining 48 hours in water, but they must be planted within 15 days; after one month the germinating capacity is greatly reduced. At the end of 3 months, scarcely 50 % of the seeds germinate and after 6 months, barely 10 %. One hectolitre of cones yields on an average 4 kg. of clean seed. It is preferable to gather the cones from the trees *in situ*, rather than purchase seed of doubtful freshness at a high price on the market.

One of the most important elements of success in this reafforestation work is the ripeness of the seed employed. The young seedlings are, however, very susceptible to the winter frosts and to drought; they should therefore be provided with some kind of shelter such as shrubs, straw, boughs, stones etc. to intercept the sun's rays. On broken ground the seeds are sown on suitable plots in trenches, located so as to afford the

greatest amount of shelter from the sun and the cold winds. Cedars should be sown in conjunction with pines as the latter serve as a protection to the young plants and can be removed when likely to become injurious.

The chief object in view should be the planting at the greatest number of points of semi-isolated, seedbearing trees, which would ultimately effect the natural reafforestation of the adjacent zones.

The author concludes by advising that reafforestation experiments should be extended, not only in the pre-Alpine Provençal district, but also further north wherever suitable areas are found, whereas in the south on the littoral slopes where there is less danger of frosts, cedars could be planted at some 1100 to 1200 m. or even higher. The extension of the area planted is advocated, as the cedar is not only valuable for soil restoration and economic purposes, but possesses great beauty; it is moreover easily cultivated under the conditions described and therefore highly to be recommended to all interested in reafforestation. G. A. and G. A. B.

58. Balsa Wood.

NEUFERMANN, F. Das Balsa holz, in *Der Tropenpflanzen*, Nos 3 and 4, pp. 49-52. Berlin, 1922.

A wood from Tropical Africa which had formerly been regarded as worthless has recently become of considerable importance. This is the wood of *Ochromalagopus*, generally known under the name of "balsa" or "raft", probably because of the purpose for which it was originally employed. The author states in fact that, several rivers of the virgin forests of Costa Rica have been crossed on a raft made of this identical wood which is very resistant in comparison with its weight. Three trunks about 30 cm. in diameter and 3 m. long, when bound together with lianes make an excellent raft capable of transporting 6 persons with their baggage across a river of considerable size. The natives use this wood also for sharpening razors. So far as the author knows it is employed only for the above mentioned purposes.

The young plant has no branches during the first year but reaches a height of 12 metres, its girth being 10 cm. and the diameter with the pith 2 to 3 cm. Afterwards 3 branches, are formed one of which grows vertically to a height of 3 m., subsequent branches are shorter each year. When the tree grows amongst others it naturally develops in height at the expense of the lateral branches. A solitary 5 year old tree attains a height of 15 m.; its girth 1 m. from the ground may be as much as 1.30 m., but in the forest, it shoots up to 50 m. and the diameter never exceeds 60 cm.

The cortex is grey and smooth with lighter coloured scales; the bark of the adult tree cracks like that of the oak. The leaves of the young trees are long and may be 5 cm. across; the leaves of adult trees are about 25 cm. in length and are much narrower in proportion.

The flowering season is from December to January. The flowers are cup-shaped, erect and brown; the inside is yellow with a pinkish tinge. As soon as the flowers have fallen off, the fruit forms; this is a kind of siliqua about 20 cm. long and 4 cm. in thickness. The fruits rise like candles from

the ends of the branches, standing erect at first and then bending over, and splitting when ripe along 6 lines. From the siliqua there emerges a kind of silky brownish-yellow cotton that catches the wind and transports the seeds for a long distance. The seeds are small, dark and tear-shaped, about 400 to each fruit and some 100 000 to 1 kg. They are distributed along the banks of the rivers, falling into the water where they float by means of their silky pappus and are carried by the early spring foods and distributed over the inundated areas where they remain buried in the silt and subsequently germinate and grow luxuriantly. The author states that the only places where he found balsa trees in the virgin forests were in the vicinity of, or on the banks of rivers.

In Costa Rica about 1000 hectares have been planted with balsa, but these trees do not appear to develop as rapidly as those growing naturally in the forests. The trees were first planted 4 m. apart; then one out of two was removed, but at the present time none of the trunks have a diameter of over 30 cm.

Balsa wood is white with silky streaks, it is very porous and therefore exceptionally light, with age it darkens and becomes heavier. The darkest wood (Balsa colorado) is regarded as belonging to another species; but NEUERMANN considers that the difference in colour is due to the soil and the age of the individual tree, which causes the formation of a darker and more compact duramen.

The white wood consists of almost pure cellulose, while the dark variety contains more woody fibre.

The annual rings are distinct in the balsa trees of the Pacific Coast where there is a six months period of summer drought which modifies and retards vegetative growth. On the Atlantic Coast, on the other hand, where it rains even during the few so-called dry months, the balsa grows uniformly throughout the year. In the latter region the climate is hot and moist, the average temperature being 27° C and the average annual rainfall 3000 mm. From the lightness of the wood it might be supposed that it would be easily transported, but owing to its high water content when green (200 %), the removal of the trees from the place where felled to the railway is a difficult task.

The statistics of the export of wood only date from 1920 in which year about 55 000 quintals were exported, almost all of which went to the United States. It is used as an insulator in many branches of the refrigerating industry, and wherever lightness is essential, for instance in aviation and in the construction of floats, buoys, life saving apparatus, etc. It also serves as a substitute for cork which is becoming scarcer every year, also for making bottle corks, linoleum cork mats etc. and finally, in the toy trade.

Undoubtedly other uses will be found in time, as such a light wood that is both elastic and relatively resistant cannot fail to be utilised in many and various ways.

Balsa wood on account of its great porosity is easily affected and destroyed by damp. The wood of commerce still retains much of its moisture and weighs 270 to 360 kg. per cub. m., and must therefore be dried. In

the United States the MARR preservation system is adopted: the wood is dried in a vacuum and vaporised with paraffin and this renders it perfectly resistant both to moisture and heat.

The following data with reference to the resistance of wood have been obtained from the records of the National Advisory Board for Aeronautics of the United States; the breaking resistance in the case of pressure in a direction parallel to the course of the fibres ranges between 117 and 400 kg. per sq. cm., the average is 250 kg. The minimum value is thus about half that of the fir. The limits of elasticity vary from 9.77 to 119.5 kg. per sq. cm.; average 37.33 kg. The resistance to flexion is 170 to 533 kg. per sq. cm. These data refer to wood with about 3.75 to 6.00 % moisture (average 4.33 %) and depend upon the weight. The lowest values are for wood weighing 120 kg. per cub. m., the highest values are for wood weighing 325 kg. per cub. m.

The author is of opinion that Costa Rica will not be able to export more than 50 000 quintals of balsa per annum and since the forests are situated so far from the railways, the use of this wood on a large scale is not to be recommended from the economic standpoint.

G. A. and G. A. B.

59 Investigations on the Shrinkage of Timber during Seasoning.

FLURY VON PH Untersuchungen über das Schwindmass der Stammholzes bei Winter- und Sommerfällung. *Mitteilungen der Schweizerischen Centralanstalt für das forstliche Versuchswesen*. Vol. XI, Part 3, pp 273-300, Zurich, 1921.

A great diversity of opinion exists as to the amount of shrinkage, both longitudinal and transverse, which occurs in timber during the seasoning process; the differences between the first measurements taken, for instance in the winter immediately after the tree is felled, and the second measurements taken later, in the spring, or following summer, are a source of controversy between the seller and the buyer. The only studies made on the subject of this shrinkage have been of a purely scientific character, and carried out on small samples in the laboratory, so that they possess little practical value. For this reason, the author has been engaged since 1912 in careful and thorough investigations, in order to determine for purely practical purposes the longitudinal, diametric and tangential shrinkage undergone by timber that has been left to season in the open air.

The problem proposed to solve was two-fold:

1) What is the reduction in the dimensions of tree trunks left to season in the open air in the forest, whether the trees are felled in winter, or in summer?

2) How much are the dimensions of the trunks further reduced, if when the outdrying seasoning is finished, the timber is sawn lengthwise and left to become completely dry in a covered well-ventilated place, free from damp?

The following is a brief summary of the author's careful investigations given in the same order as he himself adopts:

I. EXPERIMENTS.

1) *On entire trunks: from felling until complete seasoning in the forest.* These experiments were carried out on twelve trees intended for *saw timber*; these were two specimens of each of the six following varieties: spruce, silver fir, larch, *Pinus sylvestris*, *P. strobus*, and beech; six trees had been felled in the State forest of Zofingen on Jan. 19, 1912 (winter felling), and six on June 13, 1912 (summer felling), that is to say, one sample of each tree and for each season.

These trees had grown in a wood at an altitude of 485 m.; they were from 70 to 116 years old, from 30 to 36.80 m. in height, and including bark, from 1.30 m. to 44 or 56.2 cm., in girth.

Subsequently, 24 other trees especially intended for *building timber* were felled in the State forest of Winterthur, six specimens being taken of each of the following varieties: spruce, *Pinus sylvestris*, *Pinus Strobus* and larch. Of these, 12 were felled in the winter (Feb. 13, 1912), and 12 in the summer (June 24, 1912), that is, 3 for each variety and each season. These trees came from a mixed wood at an altitude of 580 m. Their ages varied from 60 to 85 years, the heights were from 15 to 31.6 m., the girths including bark, at 1.30 m. were from 1.66 cm. to 37.6 cm.

In addition, for purposes of comparison a spruce was felled (June 24, 1912), in a wood also belonging to the first class as regards production. This tree was 67 years old, 29.8 m. high, and 37.5 cm. in diameter, including bark.

Each of the 12 Zofingen trees (saw-timber) were sawn into 3 logs 6.7 m. in length; the 25 trees from Winterthur, were left whole, except that the tops were removed for a distance of 10-15 cm. After the bark had been carefully taken off, these trees were placed in the open, on a suitable support, made of other trunks put transversely, and measured with scrupulous accuracy, the lines of mensuration being previously determined; longitudinal: measurements of the girth taken at 4 points along the trunk; transverse: 4 diameters on the top, and 4 chords uniting the extremities of a pair of orthogonal diameters, and diameters down the trunk.

Every care was taken in these measurements, special methods and instruments being used, and no alterations were made throughout the experiment. The measurement were taken, in the winter and summer of 1912, immediately after the trees were felled; also, in the autumn of the same year and in the spring and autumn of 1913 and of 1914. At the latter dates viz., after 2 years and 3 years + 9 months respectively, no further reduction in the longitudinal and transverse dimensions of the trunks could be detected, hence the first seasoning stage seemed to be complete.

It was then necessary to ascertain whether this same wood, when cut longitudinally, could undergo any further reduction in dimensions. For this purpose a second set of investigations was made on the logs 1.20m. in length that had been sawn from the first trees.

2) *Investigations on cut trunks up to the time of their complete seasoning in the open air.*

Every log of 1.2 m. was sawn in half longitudinally, and each of these halves was again sawn in two: by this means, every trunk furnished one half-trunk and 2 quarters. Many measurements of these sections were taken in the direction of the long and short diameters, radius and chord respectively, and any cracks occurring in the logs were noted. The measurements were made in the first autumn (that of 1914), in the spring and autumn of 1915 and 1916, in the spring of 1917 and the autumn of 1919.

Thus, this wood sectioned was under observation for exactly 5 years — the experiments having lasted 7 years, and 3 years and 9 nine months respectively, a long enough time to obtain practical results.

II. RESULTS. — From the copious numerical data it was discovered, in the first place, that the shrinkage in trunks seasoned in the forest only takes place during the first six months of the year after felling. There is no difference in the shrinkage of trees felled in winter or summer respectively. The reduction in the diameter after the first year, and as long as the trunk remains entire, is very slight.

I. — LONGITUDINAL SHRINKAGE.

a) *In entire trunks: seasoned in the forest.* — The reduction in length is very little, being only 0.01 to 0.06 per cent of the length of the trunk, an amount that is scarcely measurable in practical work.

b) *In trunks cut longitudinally: subsequent seasoning.* — In these, the shrinkage is more marked, and varies from 0.01 to 0.17 % of the length. No difference is observed as regards trees felled in winter or summer.

c) *Total shrinkage from the green state to complete seasoning in the open air.* On taking together the results obtained during the first and second drying periods, we get figures varying from 0.04 to 0.19 per cent. of the total length of the tree, measured when green. Therefore a plank of spruce or larch 20 m. long, shrinks 2-4 cm. The engineer alone can say if this is sufficient to affect the stability of a building, here it is enough to state that from the forestry, or dendrometric, standpoint such a reduction is practically negligible.

II. TRANSVERSE SHRINKAGE.

a) *Of entire trunks: seasoned in the forest.* Transverse shrinkage is practically far more important than longitudinal shrinkage on account of the well-known and great effect of variations in the diameter of timber.

When the trunks were measured in the autumn of 1914 (2 years, and 3 years and 9 months respectively after felling) the figures obtained were the same, or 1 or 2 mm., higher than those resulting from the first measuring. This can only be explained by some alteration and consequently slight swelling of the tree. In fact, though the trunks were perfectly healthy at the outset and most carefully placed during the experiment, the beech showed signs of fungus attack after the first year and all the other trees were similarly infected after the second year. This shows that woody trunks, even if entirely and thoroughly barked, should not be left lying on supports near the ground for over a year in the forest.

As regards the reduction in diameter taking place during seasoning in the forest, it is important to know the *maximum* shrinkage and the

time at which it occurs, for this reason, the author has only taken into account the figures giving the maximum differences.

The shrinkage in diameter proved also to be very little ; it takes place during the first year subsequent to felling, after which the diameter remains constant, except for a certain small increase after the second year occasioned, as said above, by the beginning of decomposition, and is in no way affected by the season of felling. The maximum values obtained from over 7000 measurements made during 2 years, and 3 years and 9 months respectively appear to have been :

15 % in trunks for saw-wood.

25 % in trunks for building-wood.

34 % in poles.

In the absolute values, the maximum never exceeds 8 mm. viz. at no time is it as much as one cm. Even in the spruce that was felled in the first class forest, and had broad annual rings, the maximum was only 6 mm.

It is interesting to notice that in practical forestry the shrinkage is supposed to be much greater ; it is reckoned that timber felled and measured in the winter will already in the following summer show a reduction of 3 4 cm. in diameter ; and in fact, this is frequently the case. The author, however, attributes this difference to 3 causes : a) the trunk having been measured with the bark which became much reduced, or fell off, before the second set of measurements were taken ; b) the bark having been incompletely removed, so that pieces of the cortex fell off later ; c) errors, or defects, in measurement ; d) the fractions being neglected and only the round numbers given.

Thus, if disagreements arise between seller and buyer on account of such differences in measurements, it should be remembered that they depend only to a very slight extent upon the seasoning, no matter whether the tree is felled in the winter, or summer, even when the second measurements are taken one, or two years after the tree has been cut down.

After 1 or 2 years have elapsed, the trunks are left entire, shrink no further and any subsequent reduction of their diameter can only be produced by cutting them longitudinally. FLURY'S investigations prove the percentage of reduction to be greater in poles than in saw timber, or building timber, and to increase from below upwards. Of the 6 species used in the experiments, *P. Strobus* shrink the least, while the differences in the shrinking of the other species were scarcely perceptible. The season of felling had no decisive effect.

b) *Shrinkage in trunks sown lengthways : later seasoning.* The author mentions one specially interesting fact regarding the behaviour of the pieces of trunk cut during the 5 years his experiment lasted (1914-1919). He found that whereas the halved trunks were traversed by fairly numerous cracks, the quartered trunks were quite free from cracks.

This shows that in spite of the longitudinal sectioning, the slow drying and excellent conditions of preservation, the internal tension in the trunks was sufficient to cause the formation of cracks. Therefore

when timber has to be kept for a long time, it should not be left in the original round form, but cut into planks, or beams, to prevent cracking.

The reduction of the transverse dimensions (whether in the radial or tangential direction), in cut wood is naturally greater than in whole logs, as cutting relieves the internal tension and hinders further shrink-

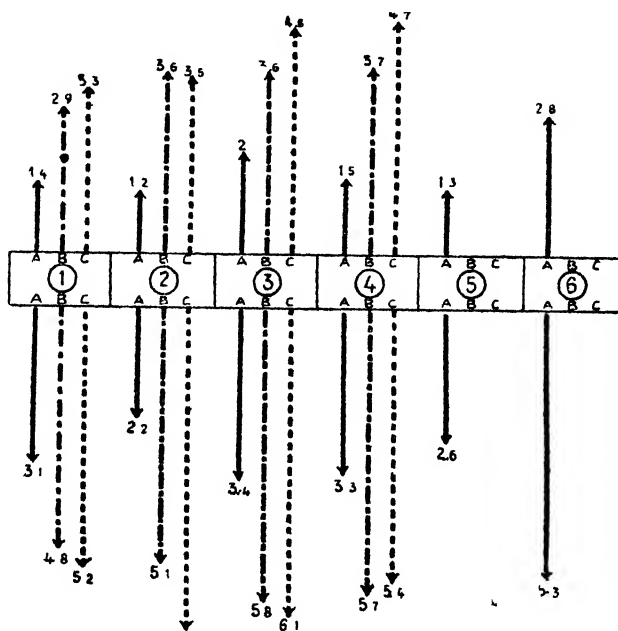


FIG 21 — SHRINKAGE OF TIMBER DURING SEASONING.

- | | |
|--------------|---------------------------|
| 1 Spruce | 4 <i>Pinus sylvestris</i> |
| 2 Silver Fir | 5 <i>Pinus Strobus</i> |
| 3 Larch | 6 Beech |

Upper abscissa, shrinkage in diameter

- A - Saw timber
B = building timber
C = poles

Lower abscissa tangential shrinkage

age in whole trunks. Here again, the season of felling has no decisive effect; there is no great difference between the various species, though a perceptible difference exists between the radial shrinkage (in the direction of the diameter) and the tangential shrinkage (in the direction of the cord) the tangential, being as is well-known, considerably greater than the radial. Finally, less shrinkage takes place in saw-timber, and more in building timber and poles.

c) *Total shrinkage, from the green state until complete seasoning in the open air.* The decrease in the diameter of timber as a result of

seasoning passes through two important stages that have to do with the method of preservation and the estimation of the value.

The first lasts from felling until the completion of seasoning in the forest; it is of great interest to the *forester* as affecting the measurement and sale of the timber.

The second begins from the time when the trunk having reached the end of first seasoning, is cut lengthwise, and as it influences the technical quality of the wood is chiefly of *technical interest*.

The season at which the tree is felled has but little effect upon the shrinkage of the timber, but is not without influence upon the duration and beauty of the wood. HARTIG prefers winter felling, chiefly because the wood of trees cut at that season has time to dry until the spring before it is open to the attack of fungi. Another very important point is that the timber should be removed from the forest without delay, for even a short stay there affects the colour and durability, in other words, the technical quality of wood. G. H. and G. A. B

BIBLIOGRAPHICAL NOTES.

60. BRESAOLA, M. Prove culturali su alcune varietà e razze di frumento, di avena e di mais, *Le Stazioni sperimentali agrarie italiane*, Vol. LV, Pts. 7-8-9, pp. 318-381. Modena, 1922

This article deals with comparative tests made in the Province of Lodi, Italy, in the years 1919-20, 1920-21 and 1921-22 with selected Todaro and Strampelli wheat varieties, and Quattrocoste (best local variety); with two Todaro oat varieties strains No. 6 and No. 9; selected Strampelli and Todaro maize, Succi variety, compared with two local varieties "maggendo giallo" and "taiolone". F. D.

61. VIDAL, D. and HEBRARD, J. Essais de blé à l'Ecole nationale d'Agriculture de Montpellier en 1921-1922. *Le Progrès agricole et viticole*. Year 39, No. 49, Vol. LXXVIII, pp. 538-544. Montpellier, 1922.

Report of experiments made with varieties of wheat which have been cultivated for some years in the South and South-east of France; varieties grown in South West of Languedoc; imported varieties which have hitherto given good results. A complete table giving all the data relative to these experiments, results and observations, is included. P. C.

62. ALLEN, R. S., Bananas mexicanas. *La Revista agricola*, Vol. VII, No. 6, pp. 320-325. San Jacinto, D. F., Mexico, 1922.

The principal Mexican States grow the Tabasco and Chiapas varieties of banana. Export from the United States 1921, amounted to 1 345 702 selected bunches, in addition to the discarded fruits ("bellacos"). Yield per hectare: 700 bunches per year, 1000 in successive years. Cost of production per bunch 0.20 gold pesos (1 peso = 24.6 pence at par), for the first year; 0.14 pesos in the following years. Immune to disease. Industrial by-product;— dried bananas. F. D.

63. ZACHAREWICZ, E. (Directeur des Services agricoles de Vaucluse), Hybrides producteurs directs *Le Progrès agricole et viticole*, Year 39, No 44, t. LXXVIII, pp 420-429. Montpellier, 1922

An article describing the observations made in 1922 on three experimental plots situated in Vaucluse and one in Le Gard, with the following hybrids: Seibel, Couderc, Noirs, Gaillard, Bertille-Seyve, Couderc blancs, Malègue. P. C.

64. TROTTER, A (Professore alla Scuola Superiore d'Agricoltura di Portici), MATON, A (Jefe del servicio de árboles frutales de la Mancomunidad de Cataluña). Descripcio de les mes importants varietats d'avellaner cultivades a Catalunya *Mancomunitat de Catalunya Departament d'Agricultura Arxiu de la Escola superior d'Agricultura*, Pt III, pp 71, figs 18, bibliography Barcelona, 1922.

An interesting article giving a description of the hazel nut varieties in Catalonia and their technical characteristics. An analytical table is included with reference to the principal varieties, and their respective qualities. The illustrations are well reproduced; many bibliographical references are given.

A list of the popular Catalonia names referred to in the description is appended. P. C.

65. GILLEKENS, G. Quelques sapins pour servir d'abri *Revue horticole belge*, Year 3, No 12, pp 179-180 Huy, 1922.

Although the common fir tree (*Abies excelsa*) is perfectly adaptable as a shade tree, *A. balsamea*, *A. brachyphylla* and especially *A. Nordmanniana* ("Sapin de Nordmann") are preferable, the last mentioned being a fine tree vigorous and resistant to cold, moisture and high winds. This species grows best on sandy soils. F. D.

66. RUBNER. Neuere Naturverjüngungsverfahren. *Forstwissenschaftliches Centralblatt*, Vol. LXVI, No 1, pp 1-23, Berlin, 1922.

This article gives an account of certain methods of restocking employed locally, concluding with the statement that no single rule can be laid down for the natural regeneration of woods as it is necessary to take into account the species, climatic conditions, soil, etc., etc., in other words there are so many purely local factors that every wood requires its own special treatment. G. H. and G. A. B.

LIVE STOCK AND BREEDING.

SYNTHETIC ARTICLES.

67. Breeding Cattle for Milk and Beef Production.

I — Will the Farmers Cow Come Back? *The Breeder's Gazette*, Vol. LXXXII, No. 5, pp. 109-110. Chicago, 1922

II — Dual Purpose Cattle in England, *The Breeder's Gazette*, Vol. LXXXVII, No. 6, pp. 141-142. Chicago, 1922. Among English Dual Purpose Shorthorns. *The Breeders' Gazette*, Vol. LXXXII No. 7, pp. 175-176. Chicago, 1922.

III. — Dual Purpose Cattle in America. *The Breeder's Gazette*, Vol. LXXXII, No. 8, pp. 207-208. Chicago, 1922. The Dual Purpose Idea has been accepted. *The Breeder's Gazette*, Vol. LXXXII, No. 9, pp. 230-231. Chicago, 1922.

IV. — TILSSON, E. H. A Brief for the Beef and Milk Shorthorn, *The Breeder's Gazette*, Vol. LXXXI, No. 13, p. 443. Chicago, 1922.

V. — ASH, E. C., Can the Red Poll become the National Breed? The Evolution of the Dual Type. *Live Stock Journal*, Vol. XCVI, No. 2538, p. 514. London, 1922.

VI. — Can the Red Poll become the National Breed? *Live Stock Journal*, Vol. XCVI, No. 2539, p. 539 London, 1922.

VII. — NEWTON C. F., Dual Purpose Cows' Persistence in Milking. *Live Stock Journal*, Vol. XCVI, No. 2540, p. 571. London, 1922.

VIII. — What the Red Poll can do. *Live Stock Journal*, Vol. XCVI, No. 2542, p. 615, London, 1922.

IX. — Milk and Beef *Live Stock Journal*. Vol. XCVI, No. 2541, p. 589. London, 1922.

X. — MILLER, W. L., Developing the Dual Purpose Herd. *The Breeder's Gazette*, Vol. LXXXII, No. 5, pp. 110-111. Chicago, 1922.

I. — The author describes the dual purpose cow (bred for beef and milk production) as follows: the animal weighs, when in good condition, 1100 to 1500 lb; during the lactation period, it yields 500 to 1000 gall. of milk, and fattens easily when dry, giving a high dressing yield; the meat is marbled and savoury. The dual purpose cow is more resistant to disease than the specialised animal bred for either milk, or beef, production.

Seventy years ago, there were many dual purpose cows in the United States; for the farmers in those days, were constrained by circumstances to keep this type of animal which has been perpetuated and improved by natural and artificial selection.

Then agriculture developed, and industrialisation and specialisation arose. Improved breeds of milk, or beef, cattle were imported, and the beef of the dual purpose cow could not compete with the cheaply produced meat sent from the ranches of the far west, while her milk yield fell far below that of the breeds of heavy milkers used to supply the towns.

The exclusive production of either meat or milk does not, however, suit all districts, and many farmers cannot specialise in either butcher's beasts, or dairy cows. The breeding of dual purpose cattle would not be prejudicial to the single purpose breeds. To obtain the first type of animal, it is necessary to breed for several years from parents belonging either to beef, or milk, breeds. Single purpose herds, on the other hand, can sometimes be improved by a dual purpose bull. Further, specialised breeds of cattle fill their own place in the industry animal products, and thus have little to fear from the appearance of a new type, while certain areas are not so well suited for rearing dual purpose cattle, as for breeding dairy, or beef, animals.

In districts where much maize is grown, it would be profitable to rear more cattle; in this case, the author is of opinion that the dual purpose cow is to be recommended.

Milk consumption in the United States will probably increase, and customers will become more particular that the milk shall come from healthy cows. As specialised animals are liable to disease, it will be necessary for dairy farms to become larger. The milk of cows belonging to large herds is more wholesome than the milk from small intensive dairy farms found in the neighbourhood of towns.

The improvement of means of communication and the extension of motor-lorry transport will promote the development of the dairy industry, as butter-factories will be able to buy their cream from little villages in the provinces and thus provide a market for the milk of dual purpose cows.

II. —The author made a tour in Cumberland and Westmorland (England), in order to obtain information on the subject of breeding dual purpose Shorthorns. These cattle have been continually selected for beef and milk production. They are well-shaped with straight back, well-developed udder, soft skin, and have usually a roan or white and red coat. The individuals are very true to type, although the author thought the adult cows rather small. On remarking this to a local breeder, the latter explained that size was not required in a dual purpose breed, for the Westmorland cows give as good milk and as much milk in proportion as larger cows; they inherit beef and milk yielding properties which they transmit to their descendants and are excellent dual purpose stock, whatever may be the weight of the females.

One farmer who was boasting of the good milking capacity of his Shorthorns remarked that all these cows are good beef animals, while another admitted that it was not easy to maintain the equilibrium between milk and beef production, but if the cows yield plenty of milk and fatten easily, their calves will be satisfactory to the breeder and the butcher, while the type can be corrected, or maintained, by having the cows served by bulls which will increase the aptitude for either milk, or beef production in the calves.

British breeders of dual purpose cattle replace the cows in their herds as quickly as possible, thus getting rid of worthless cows before they get old, and lessening the number of worn out animals to be fattened. In this way, the meat remains of good quality. The bulls used on farms where dual purpose cattle are reared are taken either from beef, dairy or dual purpose herds.

These bulls, when adult, are generally very large, long, and deep; they have very straight backs and carry their heads high. The best are the offspring of good milch cows. A satisfactory bull must have a dam with a heavy milk yield, and in some herds will have more value, if its paternal grandmother was also a good milker.

The calves are reared on whole milk. Shortly before weaning, and directly after weaning, they are given large quantities of dry, or green, forage rich in protein.

The farmers of Cumberland and Westmorland are convinced of the advantage of breeding dual purpose Shorthorns. In the opinion of these breeders, specialised herds need particular care and are very expensive

to keep. Further, beef and milk are too valuable as human food to be sacrificed to each other when it is possible to obtain both from one animal. An over-specialised cow is not adapted for breeding, as if she is a heavy milker the calf is often fattened and sent to the butcher in order that the dam's milk can be sold.

III. — The author applies the conclusions reached in the preceding article to the situation of cattle breeding in the United States. He is inclined to believe that the present agricultural crisis will have the effect of causing the farmers to return to mixed cultivation, as specialisation only increases their risks. On these mixed farms, many dual purpose cattle will be bred, although of late there has been a tendency to breed dairy cows chiefly. The consumption of milk may be expected to fall with the increased meat consumption, therefore it will be profitable to rear stock producing both milk and beef. The elements for forming herds of dual purpose animals are to be found in the Shorthorn, Red Poll, Devonshire and Brown Swiss breeds. If the author had to start such a herd, he would choose good milkers from the Milking Shorthorn and Beef Shorthorn varieties, and purchase the best dual purpose bull (out of a very heavy milker), he could obtain. He would then proceed to improve the herd's milk and beef production by making every effort to breed large strong cows of beef cattle type.

If the herd was already established, he would procure one dual purpose bull and another bull belonging to a beef breed, such as the Shorthorn, Aberdeen-Angus, or Hereford. The first bull would sire calves intended for breeding purposes, and the second the calves to be sent to the butcher.

IV. — Anyone attempting to breed Shorthorns solely for milk, or only for beef production, is working against the hereditary tendency of the breed, and thereby loses half the yield of the animals and forfeits half the profit he might obtain from them.

At the present time, dual purpose cattle are greatly needed to fertilise the crops of the maize, cotton, and wheat belts.

V — Until 1916, Red Polls did not thrive in England. This was largely due to the fact that few breeders owned animals with the typical characters of the breed. Since that time more care has been taken to obtain cattle true to type. Many large herds, amongst which must be mentioned the Gressenham herd, were broken up. Animals with Gressenham blood had a great effect in improving the milk yield of a very large number of Red Poll herds.

The author is of opinion that breeders should rear cows of the type of Meadow Ruby, Sudbourne Minerva, Dallinghoo Blossom, Gressenhall Molly etc., and weed out all animals of inferior quality. Every cow should give 800 to 1000 gals. of milk and at the same time, retain her fattening capacity. This, however, is not all that is required, for cheap milk and meat are in request. The Red Poll comes from East Anglia where there are many poor pastures, and is therefore characterised by its capacity of fattening on grass of inferior quality, and under unfavourable conditions.

VI. — If a farmer wishes to be successful in breeding Red Polls he must choose the dual purpose type which is very profitable.

The author mentions one herd of Red Polls of which the cows gave annually 800 gals of milk with a fat content of 4.3 %. The bulls produced by these cows turned the scale at about 1300 lb when 30 to 36 months old. From the time they were weaned, nearly 3 months before their sale, these animals had not been fed on any kind of cake, or meal.

The Red Poll must not be expected to give too heavy a milk yield. Over 1000 gals would be prejudicial to beef production.

To deprive the Red Poll of its dual purpose capacity would mean to lessen the longevity of the breed.

VII. — It is often said that dual purpose cows ought to be fattened and sold after their 4th or 5th calving, as their defective constitution does not permit of their producing enough milk. The author, however, mentions many Red Poll cows which when already advanced in age still yielded a large quantity of milk. 8430 Daffodil gave 920 gals annually after her 10th calf; 11117 Daffydwindilly 940 gals after her 9th; 12619 Meadow Blush 2nd 792 gals after her 12th; 17126 Meadow Blush yielded during her 15th year 930 gals of milk; 17209 Flodmoor Ruby when between 6 and 14 years of age, gave on an average 1218 gals of milk and when 16 years old, while 16925 Kitchener Daffodil gave 870 gals of milk after her 16th calving.

VIII. — The following information has been supplied by the secretary of the Society for Breeding Red Poll cattle:

Ashmoor Kashleem, after her 11th calf gave 192 gals of milk. This cow was the dam of a Red Poll bull which won the first prize and the championship at Smithfield, and also of Ashmoor Keepsake, the animal that carried off the first prize at the Royal Agricultural Show and the Dairy Competition in 1922.

Ashmoor Money gave 693 gals after her 10th calf. She was the dam of a bull that gained the first prize and the reserve championship at Smithfield.

Ashmoor Jewess, the dam of a bull winning the third prize at Smithfield, gave 3150 kg after per 9th calf. Ashmoor Florence, the dam of a bull gaining the 2nd prize at the Norwich and Smithfield Shows, gave 893 gals after her 7th calf.

Gemma gave 756 gals of milk after her 16th calf; Edna gave 785 gals of milk after her 13th calf; Lechfield Rosie Breed 1230 gals after her 6th calf; Rendlesham Florist gave 4050 kg after her 15th calf; Rendlesham Peony 998 gals after her 12th; Gressenhall Dogmar 1346 gals after her 8th; and Sudbourne Minerva 1374 gals after her 7th.

IX. Owing to their large size, there are some British Friesian cows that give much milk and others that yield a large amount of beef. The heavy milk yield of these animals is well-known, but the author draws attention to the great weight of some of the bulls and steers of the British Friesian breed. The heaviest ox at the last Smithfield Exhibition of Butcher's Beasts was a British Friesian. It weighed 2090 lb. and had been sired by a bull which is the sire of two cows, each of which gave about

2000 gals of milk in 365 days. As examples of other very heavy bulls and steers, the author mentions: Gilstone Touchstone (whose dam gave 990 gals of milk in 365 days) weighing 2750 lb in 1915, when it gained the first prize at the Royal British Agricultural Show in 1915; Golf Boter 3rd weighing 2035 lb at the age of 3 $\frac{1}{2}$ years (dressing yield over 50 %), and Gilston Stanley, a bull that turned the scale at 1 $\frac{1}{2}$ ton, in August 1922.

X. The great problem for breeders of dual purpose cows is the maintenance of an equilibrium between milk yield and meat production. The feeding of the heifers is of paramount importance in this connection. As production is correlated with assimilative capacity, it is necessary to aim at increasing the latter. The author recommends the following system of feeding young stock

Whole milk must only be given to a calf for the first week, after which time it must be gradually replaced by skin-milk, so that when the animal reaches the age of 3 months it is given no whole milk. To the skim-milk may be added "grains" (oats, maize and bran) as well as hay. This diet develops the absorption capacity. Hay plays an important part in the feeding of heifers. The best hay is obtained by sowing a mixture of meadow clover (*Trifolium pratense*) Alsike clover (*Trifolium hybridum*) and Timothy grass (*Phleum pratense*).

This system of feeding should be continued throughout the growing period and until the time the heifer is sexually mature. The author advises that heifers intended for breeding purposes should be mated directly they are full-grown, before they have lost their feminine shape, and their flesh becomes hard. As soon as they are in calf, they should be fed more liberally, in order to encourage the growth of the foetus and the development of the dam

F. S.

68 Fattening Cattle.

I. — POTTER, E. L. and WITHYCOMBE, R. (Fattening Steers). *Oregon Agricultural College Experiment Station, Station Bulletin* 193, 18 pp, figs 2. Corvallis, 1922.

II. — STARKEY, L. V. and SALMON, W. D., Comparison of Shelled Corn, Rice Meal and Velvet Beans for Fattening Steers *Bulletin* 214, *South Carolina Agricultural Experiment Station of Clemson Agricultural College*, 5 pp. Clemson College, S. C., 1922.

III. — MCKILLIGAN W. C. (Experimental Farm, Brandon Man.), Winter Steer Feeding in Manitoba *Dominion of Canada, Department of Agriculture, Pamphlet* No. 18, New Series, 15 pp, figs 3, diagrams 3. Ottawa, 1922.

IV. — MCCLARY, J. A. (Experiment Station, Lennoxville Que.) and MCCHARLES, M. D. The Winter Finishing of Steers in Western Quebec. *Dominion of Canada Department of Agriculture, Pamphlet* No. 19, New Series, 10 pp figs 2. Ottawa, 1922.

V. — BAIRD, W. W. (Experimental Farm, Nappan, N. S.), The Winter Finishing of Steers in Western Nova Scotia. *Dominion of Canada, Department of Agriculture, Pamphlet* No. 20, New Series, 11 pp. figs. 2. Ottawa, 1922.

VI. — MUIR, G. and CHAGNON, S. J. (Division of Animal Husbandry, Department of Agriculture) The Winter Feeding of Beef Cattle in Ontario. *Dominion of Canada, Department of Agriculture, Pamphlet No. 21*, 32 pp., figs. 4, diagrams 4. Ottawa, 1922.

I. STEER-FATTENING EXPERIMENTS IN OREGON. — This bulletin includes all the data published in the *Station Bulletin* No. 174 of August 1920 (1) together with additional data from experiments conducted between August 1920 and August 1922. The data here given are nearly all averages of several tests.

Lucerne hay when fed alone to two-year-old steers, produced a daily gain of 0.97 lb. per head. The animals were given a daily ration of 37 lb., of which they refused 5 lb. Chopping the lucerne hay saved waste and increased the gains 13 %; but the cost of chopping exceeded the increased value obtained.

The addition of grain to the lucerne hay increased the daily gain in live-weight by 30 %. One pound of rolled barley replaced 3 lb of lucerne hay. It made little difference whether a small ration of grain (5 lb) were fed during the whole feeding period (120 days), or a heavy ration (10 lb.) during the latter part of the period.

Feeding on lucerne hay + silage produced 64 % more gain in live weight than hay alone, while the daily cost of the ration was approximately the same. The dressing yield when silage was added was 57 % as against 55.1 % with lucerne hay alone. The most economical and satisfactory ration for fattening two-year-old steers is lucerne hay + maize silage, or peas + barley silage. A higher finish and better dressing percentage is obtained if grain is added to the hay + silage mixture; by adding 5 lb. of barley during the entire fattening period (150 days) a dressing percentage of 60.6 was obtained, but the dressing percentage was only 59.9 when 10 lb barley were given per head and per day only during the last 75 days.

II. COMPARISON OF SHELLED MAIZE RICE MEAL AND VELVET BEANS (*Stizolobium*) FOR FATTENING STEERS. — Objects of the Experiment:

- 1) to compare shelled maize and rice meal for fattening steers.
- 2) to compare velvet beans + shelled maize with cottonseed meal + shelled maize.
- 3) to determine the economy of using whole velvet beans as the sole concentrate for silage-fed fattening steers.

Twenty-four two-year-old Shorthorns divided into 4 lots of 6 animals each were used in the experiments. The cattle weighed about 1000 lb. each. Enough hogs were kept in each lot to clear up the waste grain; no extra feed was given to the hogs. All the lots had free access to block salt containing 10 % sulphur. The experiment last 119 days from December 2, 1921. The rations consumed and the gains made are given in the table.

(1) See R. 1921, No. 653. (Ed.)

The table shows amongst other things that:

1) there was little difference in the rate of gain on shelled maize and rice meal. For the first 89 days the rice meal produced slightly larger gains but when the period was extended to 119 days, shelled maize gave larger gains.

2) when rice meal was fed at the rate of 13 to 15 lb. per steer per day, it was slightly less palatable than shelled maize given in equal quantities. Further, these quantities of rice meal had a marked laxative effect which apparently reduced the gains.

3) At the prices given for the feeds, which had to be brought to Clemson College from New Orleans, shelled maize produced more economic gains than rice meal but almost $\frac{2}{5}$ of the cost of the rice meal was due to transport, therefore for places with rice-meal mills in the vicinity, rice meal would be a very cheap food. Whole velvet beans produced smaller but more economical gains than the other rations. The prices paid at Clemson College were as follows:

Shelled maize from 65 to 75 cents per bushel; rice meal 27.60 dollars per ton; cottonseed meal 42.00 dollars per ton; whole velvet beans 14.00 dollars per ton; maize silage 6.00 dollars and cowpea (*Vigna Catjang*) hay 25.00 dollars per ton.

4) When approximately one-third of the velvet beans was replaced by an equal quantity of shelled maize, the rate of gain was increased, and also the cost. This combination proved however to be more profitable than cottonseed meal + shelled maize.

5) Very satisfactory gain was produced by a ration of velvet beans + maize silage + a little cowpea hay. This shows that a complete fattening ration can be grown on the farm.

III WINTER STEER FEEDING IN MANITOBA — This bulletin is provided with chart showing graphically the seasonal rise and fall in winter steer feeding in Manitoba. The bulk of the cattle are sold from August to December, the prices being generally lowest in November and December. The number of animals on the market is smaller during the other months, and they realise more, the maximum prices being paid in May and June. Winter fattening would improve the grade of stock sold and produce better "finished" cattle, for at present only 26 % of the animals sold to the meat market are fattened.

Winter steer feeding is especially suitable for large wheat farms where there is a considerable amount of labour available during the dead season. That winter steer feeding is a profitable undertaking is shown by the results of experiments made at the Brandon Experiment Farm for many years. In each of the 4 agricultural years from 1913-14 to 1916-17 and in 1921-22, the market price of oats per bushel was 32-52-37-59-42 cents, but the price obtained per bushel fed to steers was 43-83-115-102-70 cents; in the same way, barley fetched on the market 43-65-67-110-57 cents per bushel, whereas the price obtained per bushel fed to steers was 60-117-46-143-99 cents.

Success in steer feeding depends very much on the right selection of the animals which must be of good beef type, but not of exceptional

Results of Steer Fattening Tests (119 days).

	Shelled maize, Cottonseed meal, Maize silage, Cowpea hay.	Rice meal Cottonseed meal, Maize silage, Cowpea hay.	White velvet brans, Corn silage Cowpea hay	Shelled maize, White velvet, beans, maize Silage, Cowpea hay.
	lb.	lb.	lb.	lb.
Average initial weight per steer . . .	1002.16	999.10	997.33	998.844
Av. daily gain per steer . . .	2.37	2.22	1.96	2.08
<i>1 lb. daily feed per steer</i>				
Shelled maize	9.55	—	—	3.93
Rice meal	—	9.14	—	—
Cottonseed meal	3.22	3.22	—	—
White velvet beans	—	—	13.19	10.00
Maize silage	41.18	40.55	34.10	34.4
Cowpea hay	1.13	1.13	1.13	1.13
<i>Feed required for 100 lb. gain:</i>				
Shelled maize	390.26	—	—	188.57
Rice meal	—	415.24	—	—
Cottonseed meal	136.23	145.48	—	—
White velvet beans	—	—	671.07	480.59
Maize silage	1738.27	1827.78	1736.08	1656.39
Cowpea hay	17.88	51.13	57.75	54.48
<i>Feed cost per 100 lb. gain . . .</i>	\$ 13.57	\$ 14.86	\$ 10.63	\$ 11.41
Pounds pork produced	257	12	27	90

excellence, as thinner cattle bought at feeder prices make more profit. The experiments carried out at Brandon during the winters of 1916-17 and 1921-22 show that good feeders gave a profit of 16.93 % on the capital invested, as against 12.33 % obtained from extra choice steers.

Beef cattle are usually fattened at Manitoba when from 2 to 3 years old. Experiments conducted at Brandon show that the two-year-olds gained 2.1 lb. per day and made \$8.99 profit per steer as against 1.7 lb. per day gain and \$6.60 profit per steer for the 3 year-old cattle.

The high cost of buildings is probably the greatest obstacle to an increase in the winter feeding of cattle. An experiment has however been made at Brandon Experimental Farm which shows that very limited shelter of a primitive character, such as a row of stalls with roof of poles and straw and back and sides of boards, or even a dense natural wind-break is all that is necessary for the animals to fatten well. A good supply of water and a dry bed with plenty of litter on which the cattle can lie down are both very necessary; the frozen lumps of manure should be thrown out of the shed daily.

The average daily gain in weight per head for the steers fed outdoors was 1.21 lb., as compared with 1.39 lb. for those fed inside. Cattle kept for 3 years in a primitive shed of the type described above gained on an

average 1.64 lb. as compared with 1.58 lb. gained by the animals in an expensive cattle barn of masonry.

The steers can be given as roughage, oat or barley straw, hay, maize stalks, maize or sunflower silage.

It is better to make silage of the maize stalks, rather than to dry them, for in a test at Brandon it was found that steers fed dry maize fodder only made an average daily gain of 1.44 lb., while those fed maize silage gained 1.88 lb. per day. Thirty pounds a day is a good allowance of silage for beef cattle.

IV. THE WINTER FINISHING OF STEERS IN WESTERN QUEBEC. —

The raising of beef cattle is no longer the chief source of income for the farmers of the Eastern Townships, as it used to be forty years ago, but there is still a considerable demand for well-finished animals, and the winter-feeding of steers is a good way of using the roughage produced on the farm. The chief bulky fodders used for fattening steers are Timothy hay (*Phleum pratense*) alone, or mixed with clover; maize silage, sometimes mixed with sunflowers, and a few roots, usually swedes, although mangels are more economical. A little grain, either oats or barley are also fed.

The ration fed to steers after they are put in the shed depends largely upon their condition when they left the pasture in the autumn. Animals coming off the grass in rather a thin condition, and which are to be fed for upwards of 6 months, should be started on 50 lb. ensilage per day and hay *ad lib.* for four weeks. After that, grain at the rate of 2 lb. per day may be given and gradually increased to 7 lb. or more, while the silage ration is gradually decreased to 25-30 lb. per day.

Steers coming off the grass in fairly good condition and that are to be fed in the shed for a shorter period, say 3 months, ought to be given at once a grain ration of 2 lb. per day which is to be increased to 8 or more lb.; ensilage at the rate of 30-40 lb. per day and hay *ad lib.*

The following are some suitable grain mixtures.

- 1) Ground oats, ground maize, bran and cottonseed meal (2 : 3 . 1 . 1).
- 2) Ground oats, ground barley, maize meal, cottonseed meal (2 : 2 1 : 1).
- 3) Ground mixed grains, maize meal, cottonseed meal (3 . 2 : 1).

Rations suitable for the conditions in the Eastern Townships are:

1) Hay 10 lb.; ensilage, beginning at 35 lb. and finishing at 25 lb. with No. 2 grain mixture (given above) beginning at 2 lb. and finishing at 8 lb. per steer daily.

2) Hay 10 lb.; roots beginning at 55 lb. and finishing at 35 lb. with No. 1 grain mixture beginning at 2 lb. and finishing at 10 lb. per steer daily.

In order to ascertain the value of hay and ensilage fed, careful records were kept on a group of 46 steers (mostly grade Shorthorns) during the winter of 1921-22 at the Experimental Station Lennoxville, Quebec. Length of test 179 days.

Ration. for the first month, hay and ensilage, then 2 lb. meal per day

were added, the amount being increased by 1 lb. at the beginning of each month up to 6 lb. per day. The average daily ration of hay was 10 lbs.; of ensilage (maize and sunflower) 30 lb. The feed required per 1 lb. gain was: 6.47 lb. hay + 19.39 lb. ensilage + 2.55 lb. meal.

The animals left loose in the pens utilised their food better than those tied up in the stalls. In 4 years' work at Lennoxville Station the following were the average amounts of feed required per pound gain by the loose and tied animals respectively: 7.0 and 7.8 lb.; ensilage 17.4 and 18.8 lb.; meal 2.28 and 3.04 lb. Cattle fed loose in pens must, however, be dehorned.

V. THE WINTER FINISHING OF STEERS IN WESTERN NOVA SCOTIA. — The author gives tables containing the summary of the results obtained during tests carried out for 8 years at the Experimental Farm, Nappan, N. S. The conclusions reached from these tables is that a good average herd of steers (Shorthorns) of beef type can make an average daily gain of 2.02 lb. per head at an average cost of 25.44 cents per steer. The average profit over cost of feed consumed may be 24.41 dollars per steer, with feed prices averaging about 8 dollars per ton for hay, 2 dollars per ton for roots; 43.50 dollars per ton for meal and an average difference between buying or rearing cost and selling price of 2.68 dollars per hundredweight.

The tests at Nappan also showed that the steers left loose in box-stalls utilised their food best.

From the series of tables giving a summary of the results of ten years experiments at Nappan it is seen that: 1) the younger steers make better and cheaper gains; 2) heavy steers show an average daily gain per steer of 0.08 lb. at a cost per lb. gain of 0.26 cents less than light steers. 3) intensive feeding (50 % more roots and 50 % more meal) gives slightly better gains, but leaves less margin of profit if the animals are already in good condition; 4) the addition of 2 lb. molasses per head and per day increases the rapidity of the daily gain in most cases but decreases the profit per head; 5) feeding silage + roots increases the live-weight more and at less cost than giving either silage or roots alone.

The average feed required to produce 100 lb. gain covering a period of 8 years was: 751 lb. hay, 358 lb. meal, 1997 lb. roots.

VI. THE WINTER FEEDING OF BEEF CATTLE IN ONTARIO. — This bulletin confirms the main statements made in the three preceding bulletins respecting the winter fattening of beef cattle, and treats at greater length of the practice of dehorning. Since it is generally allowed that cattle utilise their rations better and fatten quicker when they are left in the stalls, it is necessary to remove their horns in order to prevent the steers from injuring one another and to hinder the stronger animals from keeping weaker individuals away from the feeding-racks etc., and facilitate work in the cattle-shed. The best means of dehorning is to apply caustic potash to the buttons in young calves. Method: *For calves aged 8 or 10 days:* Clip the hair away from the buttons, wash with soap and water and dry. Apply vaseline, or crude petroleum,

to the head for an inch or so above the button, but not letting it cover the button itself. Take a stick of caustic potash, wrap it in paper as a protection to the hands, moisten the tip of the stick and apply it to the buttons, rubbing it gently for 3 to 5 minutes till the latter become red, or, which is better, rub on 3 or 4 times at short intervals, allowing the potash to dry on the horn button each time. *For older calves*: cut off the top of the horn, avoid causing bleeding if possible, and then rub on caustic potash. The calf suffers some slight pain for an hour or two, but not for longer, if the treatment has been carefully applied. *For adult steers*. On some farms an ordinary fine toothed meat saw is used, but a special dehorning saw has been manufactured. The authors give the names of several dehorning shears, or clippers. The Keystone Dehorner, and Dr. Levitt's Dahorner have been used with great satisfaction on several farms and Stations in Canada. Other dehorning devices are: the Perfection Calf Dehorner, the Convex Dehorner and the Newton and McGee Dehorner. Houses supplying these various implements: Ontario Veterinary and Breeders' Supply Ltd, 72 Dundar St., E. Toronto (Canada), Winnipeg Veterinary and Breeders' Supply Ltd., Winnipeg Man (Canada); Sharp and Smith 157 N Michigan Boulevard, Chicago, Illinois (United States).

As fattening rations, the authors recommend (parts by weight) 1) bran 1 + oats 1 + barley or maize 2 + oil cake or cottonseed meal 1. Increase the barley or maize toward finish, 2) bran 1 + barley or peas, or oats 2 + maize 2 + oil cake or cottonseed meal 2, 3) bran 1 + oats 2 + barley 1 + maize 1 + oil cake meal 2. Oil cake is to be preferred to cottonseed meal when the ration is wanting in succulent foods. Replacements of grain, other than those indicated, might be, gluten meal in place of oil cake or cotton-seed meal; screenings in place of oats or barley; extra oats or screenings in place of bran, and gluten feed in place of maize. The steers receive 1 lb. of the mixture per head, per day at the start and 8 lb. at the finish; the usual rate of increase is 1 lb. per week.

Rations (in pounds).

1) hay, (preferably clover) 8-10 + silage 35-45 + grain mixture No. 1 (given above).

2) Hay (preferably clover) 4-5 + hay (oats and peas) 4-5 + silage 35-45 + grain mixture (No. 1) 1-8.

3) Hay (preferably clover) 6-8 + straw (oat or barley) 4-5 + silage 25-30 + roots 25-30 + grain mixture (No. 2), 1-8.

4) Hay (preferably clover) 10-12 + roots 50-60 + grain mixture (No. 2) 1-8.

5) Hay (preferably lucerne or clover) 12-20 + dried beet pulp (soaked before feeding) 3-5, dry weight + grain mixture (No. 3).

It is better to feed twice (morning and evening) rather than three times daily, for the animals are less disturbed and the workers have the midday period free for other duties.

F. D

69. Chaff, Straw and Prickly-Pear Skins (1) as Forage.

I. — RAMIREZ DÍAZ, C., Experiencias sobre alimentación de animale, vacunos. *Boletín de la Sociedad Nacional de Agricultura*, Vol. LIII, No. 98 pp. 545-551. Santiago de Chile, 1922.

II. — TOUPIN, G. (Professor at the Oka Agricultural Institute). Usage économique de la paille dans le rationnement des vaches à l'entretien. *Scientific Agriculture, La Revue agronomique Canadienne*, Vol II, No. 5, pp. 172-175. Gardenvale, P. R., 1922.

III. — HANMANTE, N V Experience of Prickly Pear as an Emergency Cattle Food, *The Agricultural Journal of India*, Vol XVII, Part IV, pp. 389-391 Calcutta, 1922

IV. — STEAD, A. and WARREN, F. N. S Prickly Pear, Its Value as a Fodder for Sheep in Droughts and in Ordinary Times *Union of South Africa Department of Agriculture Bulletin*, No 4, 12 pp, figg 2, diagr 1. Pretoria, 1922.

An account of the experiments made by the author in the "Quinta normal de Agricultura" di Santiago del Cile with "Weeds food", a feed prepared by the firm of Correa y Cia from chaff and cereals mixed in different proportions, according to the class of animals to which it was to be given.

The feed on analyses (carried out at the "Estación agronomica" of Santiago) was found to contain: dry substance 90.3 % — available protein 16.3 % — fat and carbohydrates 80.9 % nutritive ratio 1:3.9.

In the ration given to 4 calves the "Weeds food" was gradually increased from 1 to 4 kg. per head and per day, being substituted for linseed cake; the animals were also fed lucerne hay of average quality and maize silage. Length of experiment: 120 days. Average daily increase in live-weight, per head 574 gm.

A young bull fed for 114 days on "Weeds food" (the amount being increased from 1.5 kg. at the beginning to 2.5 kg. at the end of the experiment) + linseed cake (from 0.5 to 0.6 kg.) + lucerne hay (from 3 to 4 kg.) + maize silage 6 kg. gained on an average 1050 gm. per day; another young bull given "Weeds food" 4 kg. + hay 8 kg. + maize silage 6 kg. gained on an average 1200 gm a day.

The author remarks that these results compare well with those obtained in Italy with "Fruges lin" or "nurritivo Squassi" mentioned in No. 77 of the *International Review of the Science and Practice of Agriculture*, January 1922.

II. — Oat straw contains 1 % of available protein, and 48.8 nutritive units per 100 kg. so it is not sufficient to form by itself a winter maintenance ration for cows. A cow of 500 kg. needs, for such a ration, from 6 to 10.5 kg. of dry substance + 3.5 available protein + 3963 kg. of nutritive units: the nutritive ratio ranging from 11.0 to 11.6. The author therefore advises the following supplement: oats, or chaff + bran +

(1) See R. 1921, No. 59. (Ed.)

maize + linseed cake (3:3:3:1) with other feeds according to the following rations (in kg. per cow of 500 kg.):

- 1) Straw 5 + mixture (No. 2) 5; nutritive ratio 1:10.8.
- 2) Straw 5 + clover 4; nutritive ratio \times 1:11.2.
- 3) Straw 2.5 + mixed hay 6.5; nutritive ratio 1:13.4.
- 4) Straw 5 + maize silage 20; nutritive ratio 1:20.
- 5) Straw 5 + maize silage 15 + bran or mixture (No. 1) 5; nutritive ratio 1:16.
- 6) Straw 2.5 + maize silage 15 + bran or mixture (No. 1) 5; nutritive ratio 1:11.5.
- 7) Straw 5 + roots 15 + bran or mixture (No. 1) 5; nutritive ratio 1:11.5.
- 8) Straw 2.5 + forage maize 7.5 + bran or mixture (No. 2) 5; nutritive ratio 1:12.8.

III — On the occasion of the 1918-1919 famine in the East Deccan (British India) and of the consequent shortage of forage, attempts were made to feed the cattle on the skins of prickly-pear fruits (after they had been singed to remove the prickles) cut up in the ordinary forage cutter and mixed with a little cotton-seed cake. The satisfactory results obtained and the stove (which was similar to that of a blacksmith) used for singeing the skins were described by J. B. KNIGHT (*Bombay Department of Agriculture, Bulletin* 97, 1920). Subsequently, the tests were repeated on a larger scale (1583 head) and the results which were very satisfactory are described.

The skins of the prickly-pear fruit cannot serve as the sole ration for cattle, nor even as a maintenance ration, since their nutritive value is very low, and they are apt to produce diarrhoea; both defects are, however, corrected by the addition of 0.9 kg. cottonseed-cake, and 0.9-1.2 kg. dry grass per head and per day. Steers kept on this ration from the middle of February until the middle of June are capable of doing any work, even the heaviest. Old and weak animals can live on this diet, but do not regain their strength, young cattle that are in good condition, on the other hand, soon get accustomed to this ration and thrive on it.

IV. — At the Grootfontein School of Agriculture, Middleburg, Cape Town, experiments in feeding sheep on skins of prickly-pear fruits have been carried out for over a year, in order to ascertain the value as a forage for stock in times of drought and subsequent scarcity.

Ten castrated animals, 3 ½ years of age, with an initial weight of 43 kg. were kept from March 1921 in a small inclosure and fed almost, or quite, exclusively on the skins of *Opuntia* fruits (not a very prickly variety, but with some prickles), which they ate *ad lib.* After the fifth day, the sheep were given no water to drink. The course of the experiment and its results were as follows.

Subsequently, 4 sheep that had been weakened by this ration received in addition to prickly-pear skins *ad lib.*, about 90 gm of lucerne hay per head and per day from the 197th to the 267th day; this treatment quite restored them to health.

Days	Ration	Weight
1 25	5 9 kg skins + 0 27 kg lucerne hay	Stationary
26 31	7 2 kg skins	Decreasing
32 41	5 8 kg skins + 0 22 kg straw	Decreasing
42 87	6 4 kg skins	Decreasing
88 90	0 9 kg lucerne hay	Decreasing
91 112	6 8 kg skins	Increasing
113 117	2 5 kg skins + 0 15 kg of lucerne hay	Increasing
118 196	5 9 kg of skins	Decreasing

Another portion of the experiment lot continued to be fed with skins only

Results 1) The sheep readily ate prickly-pear skins During the first 196 days they consumed on an average 5 84 kg, and in the following 71 days 5 56 kg which was a large quantity

2) Sheep fed on prickly-pear skins do not need water to drink, 9 of the animals used in the experiment were given no drinking-water for 260 days, and 4 of the others received none for over 400 days

3) A ration of prickly-pear skins alone does not suffice to keep sheep in good condition still less is it enough for ewes during lactation, though they can live on it for at least 9 months Hence the prickly pears may be regarded as a very useful emergency feed during times of shortage of forage In 270 days the animals used in the experiments lost on an average 13 6 lg of live-weight per head this loss would have been greater if the animals had not been kept for 3 days on lucerne hay from about the middle of the experiment

A better method of preparing the prickly pear skins for sheep is to snipe the prickles with a small lamp while the fruits are still on the plant this enables the sheep to eat the fruit from the bush and avoids the labour of picking

The authors remind the reader that more than thirty years ago, Dr MACOWAN of the Department of Agriculture of Cape Colony advised the use of the prickly pears as forage and they state that the same advice was given to the Texas stock breeders in *Bulletin* No 74 of the Department of Agriculture of the United States F D.

General

70 Development and Strength of Jawbones of Domestic Animals.

GRAU, A Sur l'examen de la mâchoire dans le choix des reproducteurs *Comptes rendus des séances de l'Académie d'Agriculture de France*, Vol VIII, No 36, pp 933-937 Paris, 1922

It is amongst the domestic animals and more especially amongst the breeders, that the well-developed maxillary bones are to be found In order to form an opinion attention should be given to the placing depth and amount of separation of the lower jaw bone The size of the forehead and of the head will give a comparatively correct idea of the development of the upper jaw, in order to be still more exact it is advisable to handle gently

The mastication muscles of young animals can also be strengthened. To do this they should not be harnessed too soon. Suction favours the development of the muscles of the mouth. If not nourished by the mother it is better not to use a trough, but a form of feeding bottle which will encourage sucking. For a similar reason it is wiser to avoid a feed too finely ground for animals still in the early stages of development. If later, meal is given to the young animals, it is better to mix with fodder which requires mastication.

F. S.

71. Food Value of Coconut Cakes, Coconut Meal and Ground Linseed for Dairying.

HANSSON, N Vardet av Kokoskakor, Kokosmjöl och Linfrö vid utfrogningen av mjölkkor, in *Kungl. Landbruks-Akademiens, Handlingar och Tidskrift*, No. 6, pp 497-519, tables 7. Stockholm, 1922.

During the winter months of 1921-1922 the Department for Feeding Research of the Swedish Agricultural Experiment Station has carried out feeding experiments in order to ascertain the food value of coconut cakes, coconut meal (extracted) and ground linseed for dairy cows. The feeding experiments with the coconut foods have been carried out as group trials with 42 cows at two farms. In these experiments a daily ration per cow of 1.5 kg of coconut cakes or of 1.5 kg of coconut meal was replaced by a ration of 1.8 kg. of wheat bran and 0.15 kg. of peanut cakes. With linseed only one trial (carried out as a period trial) has been made. In this experiment a ration of 1 kg. of wheat bran was given. The results obtained in these experiments can be summed up as follows :

1) That coconut cakes and coconut meal are excellent foods for dairy cows with a favourable effect on the milk production and in dietetic respects.

2) That coconut cakes as well as coconut meal increase the percentage of fat in milk.

3) That this effect is dependent partly on the percentage of fat in the food mentioned, so that cakes containing 7-8 % of fat, on the whole, increase the percentage of butter fat in milk more than meal containing only 3-4 % of fat.

4) That this effect of the coconut foods furthermore is dependent on the amount of the coconut food given daily, the length of the periods of the trials and the other foods given at the same time.

5) That the capability of the coconut foods to increase the percentage of butter fat in the milk is so general that of 30 cows, which have been given this feed in these experiments, 28 have reacted in the same direction, while it was found that one of the two other cows was suffering from an abnormal state of health.

6) That if consideration is given to the effect of the coconut foods both as regards the quantity of milk and the production of fat, about 0.85 kg. coconut cakes of the composition proved here ought to be considered equal to one food unit.

7) That under the same conditions about 0.90 kg. of coconut meal with 3-3.5 % of fat is required to equal one food unit.

8) That ground linseed given to dairy cows considerably increased both the percentage of fat in the milk and the total butter fat production.

9) That 1 kg. of linseed of normal composition seems to have about the same nutritive value as 1 kg. of ground oats plus 1 kg. of wheat bran.

10) That ground linseed is well liked by the cows, has a good dietetical effect on the animals as well as a favorable influence on their coat of hair.

N. H.

72. The Death Camas species *Zygadenus paniculatus* and *Z. elegans* as Poisonous Plants.

DWIGHT, M. C. and CLAWSON, A. B. in U. S. Department of Agriculture, *Bulletin No. 1012*, pp. 1-25. Washington, 1922.

The various species of *Zygadenus* known in North America under the collective name of "death camas" have frequently been noted as poisonous to animals (1); a study of the comparative toxicity has, however, been neglected and forms the object of the present work.

In the case of sheep feeding on the leaves and stems, the minimum effective dose for *Z. gramineus*, *Z. paniculatus*, *Z. elegans* respectively was found to be as follows:— 0.33 lb., 1.98 lb and 3.74 lb. The results obtained with various parts of the plant are given. It appears that *Z. paniculatus* is about one-third as toxic as *Z. gramineus*, and *Z. elegans* about one seventh. *Z. paniculatus* may cause heavy losses of livestock, but *Z. elegans* probably does little or no damage under normal conditions.

F. D.

Breeding.

73 The Genetic Work of Houwink.

LORSY, I. P. and KUIJER, K. A. A Preliminary Statement of Houwink's Experiments Concerning the Origin of Some Domestic Animals. *Genetica Nederlandsch Tijdschrift voor Erfelijkheid- en Afstammingsleer*, Vol. IV, Part 2, pp. 139-172, 4 plates 's Gravenhage, 1922.

For 25 years, HOUWINK has been engaged in investigations with the object of discovering the origin of at least one species of domestic animal. He has been directed in his work by LORSY, and latterly, his experiments have developed to such an extent, that he has employed an expert to assist him in carrying out his work.

In 1918, his experiments included 25 series: 1) Breeding the red jungle fowl, *Gallus gallus (bankiva s. ferrugineus)*; 2, 3, 4) Crossing *G. Gallus* respectively with *G. Sonnerati*, with *G. varius* and with Silkies; 5) crossing partridge coloured Wyandottes with White Leghorns (transmissions of egg colour); 6 and 7) crossing *Anser hyperboreus* respectively

(1) See R. 1922, No. 590. (Ed)

with *Branla canadensis* and *Cynopsis cygnoides* (1); 8) crossing *Lepus cuniculus* with *L. europaeus*; 9) crossing *L. cuniculus domesticus* with *L. europaeus*; 10) crossing various forms of *L. cuniculus domesticus*; 11) crossing white and spotted ferrets; 12 and 13) crossing dog and wolf; jackal and dog; 14 and 15) testing the relative purity of "Dackels" and wolfdogs; 16-20) crossing cintate goats; cintate cattle; domestic and wild swine; Italian and Dutch bees; horse with female ass and mare with jack ass; 21) transmission of egg-production in fowls; 22-25) crossing *Tadorna Tadorna* with *Anas boscas*; white ducks with wild ducks; canaries with various other singing-birds; the common tortoise with the Barbary Tortoise.

Experiments 1 to 3, 6, 7, 17, 24, 25 have been described by the two successive assistants of HOUWINK in the 3 following publications:

1) H. N. KOOIMAN. Over de betcekenis van het kruisen van individuen, behoorend tot verschillende Linné'sche soorten voor het ontstaan onzer huisdieren (*On the Importance of Crosses Between Individuals Belonging to Different Linnean Species as Regards the Origin of Our Domestic Animals*), *Ardca*, 1918, pp. 108-114 (referring to experiments of the series 1 to 3).

2) KUIPER K. Onderzoekingen over kleur en teekening bijrunderen (*Heredity of Coat Colour in Cattle*). *Genetica* 1920, pp. 137-161 (referring to the experiments of series 17) (2).

3) KUIPER K. Steriele soortsbastaarden (*Sterile, Species-Hybrids*). *Genetica*, 1920, ppp. 289-299 (referring to the experiments of series 6, 7, 24, 25)

In 1921, HOUWINK was obliged to close his Experiment Station at Moppel. His experiments on wild species of fowls will be continued by a Netherland Society for the advancement of scientific knowledge, while the crossing of hares and rabbits will be continued by the Wageningen Agricultural Institute.

In the work under examination, some important differences are mentioned between the reciprocal crosses of jungle fowl and Silkies.

These experiments were suggested by the work of Prof. A. v. TSCHERMAK, Ueber das verschiedene Ergebnis reziproker Kreuzung von Hühnerrassen und ueber dessen Bedeutung für die Vererbungslehre (Theorie der Anlagenschwächung oder Genasthenie), *Biologische Zentralblatt*, Vol. 37, pp 217-277, 1917. The authors describe the work of TSCHERMAK and other previous experimentalists, as well as their own, and they arrived at the following conclusions:—

The reciprocal crosses made by HOUWINK between the jungle fowl (*Gallus gallus*) and the Silky do not confirm the theory of "genasthenia" (viz., the weakening, "Valenzminderung" of hereditary factors in successive generations) put forward by TSCHERMAK, although the first results appeared to prove it. The differences observed between the different crosses, cannot be explained by sex-linkage, but do not show any

(1) See R. 1922, No. 1329. (Ed.)

(2) See R. 1921, No. 837. (Ed.)

regular paternal or maternal dominance. Segregation, though it does not always take place in the normal Mendelian ratios, shows no revision of these ratios

The authors conclude as follows.

"We believe that our experiments prove that the crossing of "pure" breeds may give rise to many unexpected results, for dominant characters may be heterozygous even in pure breeds which have reproduced themselves unaltered for a great number of generations. F. D.

74. Identification of Hereditary Transmission of Characters.

HEIDEMA, A. W. Moeten alle dieren in een Stamboek worden ingeschreven? *Het Paard*, Year 28, No. 43; Het leren kennen der overerving van eigenschappen *Ibid.*, No. 44, Het heren kennen der overerving van eigenschappen *Ibid.*, No. 45 s'Gravenhage, 1922.

It has been considered possible in the interests of studies on the hereditary transmission and inheritance of certain characters, to trace out in the genealogical records the history of a horse, with a detailed description of the characters of each generation.

In practice it is not possible to obtain a direct detailed record of all generations of a horse. This involves expense and the horse-breeders content themselves with merely registering the animals which appear promising. On the other hand, the State will only hold itself responsible for records of foals which are certain to be reared and which possess a commercial value related to their origin.

It is very difficult to give a detailed and adequate description of an animal. The expense is too great and is perhaps hardly worth the effort of the owners. A complete description includes both good qualities and defects, and it is not easy to estimate the latter to the required extent.

The actual principles of transmission of characters has been studied in experiments made with small animals and plants. Probably the results obtained may be applied to the rearing of domestic animals. But it will be necessary first to verify the results obtained by application of these principles. Stock-raisers may facilitate this work by making direct observations during breeding. Many characters are overlooked in the course of experiments viz. if the mare breeds easily or with difficulty; if the foals are produced easily or the reverse; if the mares can rear their foals; if milk is abundant; if the horse possesses good or bad digestive organs; if difficult to feed; if the animal goes well in harness etc. These facts should complete the records for the genealogical stud-register. They should be collected and verified in the case of future progeny and it is probable that this method would have an important effect on stock raising.

F. S.

75. Mendelism in Fur Sheep Crosses.

DUCK, R. W. *The Journal of Heredity*, Vol XIII, No 2, pp. 63-68, figs. 4. Washington, 1922.

Investigations made by the Animal Husbandry Department, Syracuse University (New York State), on the zygotic cause of red lambs (more of

a chocolate colour), when fur sheep are crossed with longwools on their grade offspring.

The problem is of a practical interest, provided that an attempt is made in the different countries to acclimatise and encourage the karakul type of fur sheep (1).

The author states that homozygous karakul sires crossed with Longwool ewes gave complete dominance of the black fur. About one-third of the offspring of a ram were mixed, red, white and spotted.

The appearance of red lambs has been noted by several investigators:— R. O. WAHL of South Africa (Grootfontein School of Agriculture, Middleburg [Cape], red lambs from karakul ram \times karakul ewes; F. F. DAWLEY (Payetteville, New York State) from karakul ram \times Lincoln, Leicester, Cheviot, Black faced Highland and Cotswold ewes.

Occasionally red rams are found, but all the furs are sold under the name of karakul whether coming from pure bloods or grades. F. D.

Special.

76 Improvement of Horses in the Dominican Republic.

I — HARE, F. Los caballos y la crianza del caballo. *Secretaría de F. de Agricultura e Inmigración, República Dominicana, Revista de Agricultura*, Year XVII, No 1, pp 5-9 Domingo, 1922

II. — Semental "Rex Selby". *Ibidem*, pp 9-10.

In the Dominican Republic horses are used for four purposes the chief use being for the saddle and others for pack animals and light and heavy draught horses. Owing to their frequent use in the mountain districts, the animals are smaller than the light horses common in other countries, in fact the horses are at present, generally too small. The north-American saddle horse is a decided improvement in this respect.

To encourage general improvement, the Government has entrusted to the "Estación agronómica" at Haina, a first-class stallion, type "Rex Selby", to be held for free use by the farmers. F. D.

77 The Effect of the Age of the Sire and Dam on the Quality of Offspring in Dairy Cows.

ALLEN, C. L. (Cornell University, Ithaca, N. Y.). *The Journal of Heredity*, Vol XIII, No. 4, pp. 167-176, figs 7. Washington, 1922.

The Statement that an animal is more valuable for breeding purposes when it has reached full growth is based on the following reasoning: either the mature animal because of its physical development must be more able to impress its characters on its progeny, or in the process of maturity

(1) For Argentina, see R. 1913, No 282 and R. 1914, No. 653; for the United States, see R. 1914 Nos 929 and 1152; for South Africa, see R. 1917, No 64; for Great Britain, see R. 1915, No 1186; for Germany, see R. 1917, No. 570 (Ed)

the animal must acquire something, due to training or environment, which can be transmitted to its offspring. After a century of study, the important question is far from settled as to the possible effect of environment on the transmission of a tendency to increase or decrease certain quantitative functions.

It would be very advantageous to know definitely whether the young born of immature parents are as valuable for production and for reproducing their kind, as those born of more mature parents. It is the aim of this paper to show whether the average age of the parents of a group of high producing or superior cows is greater than the average age of the parents of a group of comparatively low producing or inferior cows. An attempt is also made to show the percentage of distribution of offspring for the various ages of both sire and dam; the age when cows actually make their best records; and whether the offspring of very young or very old animals are inferior.

The data reported in this paper were taken from the Advanced Registry Year book and the Herd books of the Holstein Friesian Association of America. The superior class of animals chosen had yielded 24 lb. or more of butterfat in 7 days; the comparatively inferior class of cows produced less than 14 lb of butterfat in 7 days. Three generation pedigrees were compiled and the following results have been obtained

There is no significant difference between the age of the superior and the inferior producing cows. An old animal will not necessarily be high producing (averages of 506 progeny); as far as the age of either parent is concerned, the young born at one period in life seem to be just as valuable as young born at any other age. Age evidently has no effect on the quality of the offspring. The sires of the superior class average 46.4 months at the birth of their offspring, and those of the inferior class rather less. The largest number of offspring were born when the sires were from 2 to 3 years of age; improvement has been based on selection of young sires rather than older ones.

A bull cannot be called an established sire until the heifers have milked at least one year, and not until he is 5 years of age. That a tested sire is more valuable is shown by the fact that 21.1 % of the superior cows are daughters of bulls of equal age, compared with only 15.9 % of inferior cows. This may seem to conflict with the opinion that the bull when old is not more valuable, but these data prove that such a bull is not more valuable as a parent.

There is a distinctly larger percentage of superior class producers born of dams of 5 years old than of low producers. This perhaps may be attributed to the fact that the superior class received better care and were bred younger.

The offspring from very young parents or from very old parents are of equal value from the productive standpoint.

On the average, cows make their best records as regards milk and butter fat production at about 6 years of age.

F. D.

78. The Appearance and Value of the Fat Deposits in Charolais and Limousin Cattle from 2 to 4 Years of Age.

LAPIAUD and BRUNET. L'apparition et la valeur des manègements chez les bovins Charolais et Limousins de 2 à 4 ans. *Comptes rendus des séances de l'Académie d'Agriculture de France*, Vol. 8, No. 36, pp. 945-956, 1 pl. Paris, 1922.

The authors have determined the order of appearance, value and significance of the fat deposits, that can be detected by palpation, in fifty young animals belonging to the Charolais and Limousin breeds.

In the case of the Charolais, the order of the appearance of the fat deposits was as follows: on the stifle-joint (this accumulation remained dominant), between the pin-bones, on and beneath the shoulder-blades and on the buttocks, where they became of considerable size before the formation of the fat deposits on the flanks, hips, chest and thighs.

The fat deposits of the Limousins were formed in the following order: first on the buttocks and stifle-joint, then between the pin-bones, on and beneath the shoulder blades, on the hips and chest, and last of all on the thigh. They were more developed and less firm than in the case of the Charolais. The buttocks were especially large, and at the end of the fattening period, the thigh attained a size never reached in the Charolais animals. The great development of these fat deposits in the Limousin cattle did not always correspond with a high meat yield. The external fat deposits give useful information as to the density of the meat; firm fat corresponds to compact, heavy meat. The net meat yield also depends on the live-weight which is essentially variable. There is no constant relation between yield and the external fat deposits; the determination of the fat deposits only serves to complete the examination of the animal. F. S.

79 The Richness of Jersey Milk.

Live Stock Journal, Vol. XCVI, No. 2598, p. 512. London, 1922

Samples of milk were taken from a Jersey herd, by the official recorder to the Kent Society. The average percentage of butter fat for the 25 cows was:

Morning's milk 4.88 %. Individual cows varied from 3.8 % to 6 %.

Evening milk 6.18 %, Variation 4.8 to 7.8 %.

Average for the day 5.5 % of the 25 cows, 4 only were under 5 %, 11 were between 5 and 5.5 %, 7 were between 5.5 and 6 % and 3 were over 6 %.

Although the majority of these cows had calved 6 months before the experiment, 21 were giving more than 1 lb. of butter fat daily, and this made nearly 1 lb. 2 oz. of the finest butter.

These samples were taken on a surprise visit.

F. S.

80. Milch Cows in Guatemala.

JACKSON, C. La raza de vaca lechera del porvenir, para Guatemala, in *Boletín de Agricultura, Industria y Comercio*, Vol. I, No. 10, pp. 411-424. Guatemala, 1922.

The sale of the dairy products of Central America is centred at Guatemala. The greater proportion of milk produced in the Republic is used for butter and cheese making and it is proposed to utilise a certain amount for condensed milk and milk powder.

The meat stock and the milch breeds are raised separately; "Durham", stands first for meat, and Holstein, Jersey, Guernsey and Ayrshire are bred for milk (especially the first two). The native breed "criolla" has been much improved by selection.

According to the author the Holstein is the best breed for milk and the Jersey for skimmed milk.

The Livestock Show held in Guatemala in 1921 gave clear evidence as to the progress made in the Republic in the raising of milch cows. F. D.

81. Feeding Experiments with Pregnant Ewes.

HANSEN, N (Diatiga och digwande modertackors naringsbehov), in *Kungl. Landbruks-Akademiens*, No. 6, pp. 429-497, tables 4. Stockholm, 1922.

During the first months of 1922 a feeding experiment with 20 pregnant ewes of pure Shropshire breed was carried out at Bjarka Säby by the Department for Feeding Research of the Swedish Agricultural Experiment Station in order to obtain data for estimating the food requirement of pregnant ewes and of milk ewes. The experiment was continued from January 20th to May 16th, the food consisting of hay, of clover and mixed grasses, turnips and mixed grain meal. This experiment as well as the results obtained by the Norwegians, JON SÆLAND and A. LALIM, indicate that the feeding standard proposed by O. KELLNER for breeding ewes should be corrected. On the one hand it appears that the pure maintenance requirement of sheep is somewhat lower than KELLNER has suggested both as regards their general requirement and their special protein requirement. On the other hand it has been proved that both the requirements mentioned increase to such a marked degree during gestation that this fact must be taken into consideration when feeding sheep in winter. The Scandinavian feeding experiments here described, compared with investigations and suggestions by ARMSBY and many others, have shown:—

1) That the pure maintenance requirement of sheep is about 1 food unit and 55 gm of digestible protein per 100 kg live weight. This requirement, however, is somewhat higher for smaller and somewhat lower for good-sized sheep

2) That the food requirement of pregnant ewes in the beginning of the winter feeding is about 1.2 food unit per 100 kg live weight with about 70 gm of digestible protein per food unit.

3) That the food requirement of pregnant ewes during the two last months of gestation is about 1.5 food units per 100 kg live weight with 85 gm of digestible protein per food unit.

4) That milk-ewes require about 2 food units per 100 kg live weight with about 100 gm of digestible protein per food unit, if they, without becoming thinner, are able to feed their lambs well. With this ration the lambs may have some food apart, especially after they are 1 to 1.5 months old.

5) That it involves no risk in the development of ewes and lambs to give the ewes, which after pasturing are in good condition, a feed ration somewhat lower in food value than that corresponding to their nutrition requirements.

The above results permit the following feeding standard for pregnant ewes and for milk-ewes to be drawn up:—

	Per 100 kg live weight		Digestible protein per food units gm
	Food units	Digestible protein gm	
In the beginning of the winter seeding .	1.0 = 1.2	70 = 84	70
During the last months of pregnancy .	1.3 = 1.5	110 = 128	85
During milking .	1.8 = 2.0	180 = 200	100

In using this feeding standard the condition of the ewes in the beginning of the winter feeding should be considered. Attention should also be paid to their size, stage of pregnancy and lambing time as well as to the food given to the growing lambs, facts which have a considerable influence on the nutritive requirement of the ewes.

H H.

82 Pork Production.

VOITELIER, CH La Production de la Viande de Porc *Revue de Zootechnie*, No 12, pp 187-201, figs 7, tables 3 Paris, 1922

The fluctuations in the price of pork are largely due to ignorance of the quality of meat most in demand, and of the food necessary to obtain a first class product.

For the last fifty years, the consumption of fresh pork has increased at the expense of salt pork. The relative value of lard as compared with lean meat has fallen.

The author is of opinion that a larger consumption of bacon, viz., of slightly salted meat from which the salt is removed before the smoking process, would be most advantageous to the pig-breeding industry. For bacon of the best quality it is necessary to have pigs weighing from 40 to 60 kg. and giving meat with a relatively small amount of fat.

In the meanwhile however, it is imperative to produce the articles most in demand i. e. fresh pork and salted pork.

The results of experiments conducted at the Wisconsin Experiment Station have proved that the nutritive value of the meat of young animals

is less than that of older pigs, but the money value is not proportionate to the nutritive value. One kg. of rather lean meat containing sufficient fat to be savoury, fetches a higher price than one kg. of fat meat.

On the other hand, it has been found that the pig's power of assimilating nitrogenous substances decreases regularly with age; further, the yield of a young pig given an insufficient amount of milk from its birth, is lower than the yield of the animal that has been more liberally fed.

From experiments carried out twenty years ago in Denmark, it appears that there is an optimum age for slaughtering young pigs after they are weaned. The determination of the right moment depends upon the net cost per kg. of meat and the condition of the market. In this connection the author mentions the following instance among others. In order to rise from 20 to 60 kg., and increase 80 kg. in live-weight, two piglings require 304 kg. of barley, whereas one pigling needs 339 kg. barley to pass from 20 kg. to 100 kg. Supposing the price of barley to be 0.70 fr. per kg., one kg. of the meat of the pig weighing 100 kg. would cost 0.245 fr. more than 1 kg. of the meat of the lighter pig. Therefore, if the price fetched by an animal of 60 kg. is higher than that paid for a pig weighing 100 kg., it is unprofitable to fatten a pig beyond the weight of 60 kg.

The method of rearing swine plays a great part in the growth of the animals and in determining the quality of their meat. The author believes that rearing pigs out-of-doors can only have a favourable effect upon the quality of the pork especially in the case of pigs sent to the butchers when they weigh 60 kg.

From these data, the author draws the following conclusions respecting the technique for: a) producing pork to be consumed fresh. The pigs must be slaughtered at the age of 6 to 9 months. They should be intensively fed, no change being made in their diet at the time of weaning, so that they may develop as rapidly as possible. The ration must have a nutritive ratio of between 1 : 4 and 1 : 5, the best foods being cereal "grains", manioc, artichokes and skim-milk; b) for producing salt pork: In order that this may be remunerative, only cheap foods must be used, grain-offal, residues, household scraps etc. Store pigs from 6-8 months old which are vigorous and thrifty make the best use of such food. If they are fed for the three months before they are killed upon foods that will improve the quality of their meat, they can be sold profitably, provided their weight does not exceed 100 kg.

E. S

83. Fattening of Yorkshire and Danish Pig Breeds.

BECK, N., LUND, A. V. and ROSTRUPP, P. 10^{de} Beretning om Sammenlignende Forsøg med som fra Statsundstøttede Avlscentre 109^d Beretning fra Forsøgslaboratoriet Copenhagen, 1922.

The authors trace the origin and the breeding centres for the Danish and Yorkshire pig breeds. The object of these farms is indicated and their development and effect on bacon production.

Fattening experiments have been made to compare the value of the two breeds. Animals of about 6 weeks old were selected, the Danish

breed weighing 15.7 kg. and the Yorkshires 13.7 kg. At the close of the experiment, the animals then about 6 ½ months old, were of almost identical weight, viz. 93 kg., but the Danish were mature 9 days earlier than the Yorkshire. The production for both breeds was about 3.68 fodder units for an increase in weight of 1 kg. A larger amount of better export quality bacon was obtained from the Yorkshire.

The authors also shew the effect of the improvement of the piggeries on the live weight. In the old sheds the requirements of the Danish and Yorkshires respectively, amounted to 3.78 and 3.68 fodder units per 1 kg. increase in weight. After the heating and cleaning arrangements were improved, 3.46 and 3.50 fodder units were apparently sufficient.

Poultry.

84. Correlation between External Body Characters and Annual Egg Production in White Leghorn Fowls (1).

SHERWOOD, R. M. *Texas Agricultural Experiment Station, Bulletin* No. 295, pp. 1-14. College Station, County Texas, 1922.

The practical importance of the question of selection of fowls for egg-production based on external characters, has been the subject of many experimental studies.

BLAKESLEE and WARNER report high negative correlation : 1) between the percentage of yellow in the ear lobes of the White Leghorn observed from October 19 to 21, and the number of days since laying ; 2) the percentage of yellow in the ear lobes and the number of laying hens when the observations were made. It appears that egg-production was highest with birds laying in October, the negative correlation with colour and ear lobes and the yearly egg records is largely an indirect one. BLAKESLEE and WARNER state also that a negative correlation exists between annual egg production and colour of ear lobes, shanks and beak.

HARRIS, BLAKESLEE and WARNER showed a correlation between yellow colour in the ear lobes of White Leghorn fowls and annual egg production of -0.05816 ± 0.0253 in 1913-14 and -0.5271 ± 0.0252 in 1914-15.

DOUGHERTY found a negative correlation between annual egg-production and colour of shanks, beak and vent. Shank and beak colour are somewhat more reliable for summer grading.

PALMER and KEMPSTER studied the physiology of the yellow pigment and reached the following conclusions : the fading of the yellow pigment from the ear lobes, beak, shanks etc. of White Leghorn and American breeds during fecundity is due to the fact that the latter deflects the normal path of excretion of the xanthophyll from these parts of the skin to the egg yolk. The xanthophyll deposited in the epidermis of the above-mentioned parts gradually disappears as the result of the natural physiological change in the structure of the skin. The thicker the epidermis, the more slowly will the xanthophyll disappear. It is impossible to restore xanthophyll

(1) See R. 1919, No. 1202. (Ed.)

to the skin of hens as long as fecundity exists, regardless of how largely the excess of pigment is fed

The adipose tissue also fails to absorb the xanthophyll from the food when laying even when fed on rations rich in xanthophyll, the pigment being excreted wholly in the egg yolk. The fading of the ear lobes, beak and shanks of the Leghorn and American breeds as the result of laying, is an index of continuous fecundity only — not heavy laying.

Correlation between standard score and annual egg production was studied in connection with the Vineland Egg Laying Contest (Illinois), 1919-20. The tables published show correlations of -0.015 ± 0.054 for Plymouth Rocks, 0.022 ± 0.085 for Rhode Island Reds, of 0.096 ± 0.059 for Wyandottes, and of 0.063 ± 0.029 for Leghorns. In all these cases there is a small negative correlation, but this is so small in relation to the probable error that it can not be considered significant.

Correlation between body weight and annual egg production was also studied. Heavy breeds (Plymouth Rock, Rhode Island Red, Wyandotte), showed a slight advantage for the average or standard weight fowls over the heavier and lighter ones. Light breeds (Leghorn etc.) showed that a few of the very lightest fowls were not good layers, apart from these few no significant correlation was observed between annual egg production and the deviation of the weight of these birds from standard weight.

The author then proceeds to describe the observations made with 128 White Leghorn hens of similar breeding.

The studies refer to the egg production in the first year of laying between October 1, 1920 and September 30, 1921, at 0 to 1) colour of shanks, 2) colour of beak, 3) pliability of pubic bones, 4) handling quality, 5) number of primary wing feathers moulted, 6) body weight, 7) width of pelvic arch, 8) capacity (measurement from tip of one pubic bone to the back point of the keel), 9) depth of body, 10) length of keel. The results are given in 19 tables and summarised. They confirm the results obtained by previous experiments and support the theory that good layers are associated with yellow shanks and beaks, pliability of pubic bones and late moulting.

This work shows no correlation between weight and annual egg production, nor between deviation from either standard or average weight and annual egg production.

There is a marked positive correlation between capacity and weight, and between depth of body and weight. A less distinct correlation is shown between length of keel and weight, and still less between width of pelvic arch and weight.

No outstanding correlation is evident between capacity, depth of body, width of pelvic arch, length of keel, and the ratios of capacity, depth of body, width of pelvic arch, and length of keel to weight, on the one hand and annual egg production on the other. In each case the correlation in relation to the probable error is small. These facts indicate that too much emphasis is being placed on these characters in common practice.

The characters studied may be divided into two classes: physiological and anatomical. The physiological characters include colour of shanks, colour of beak, pliability of pubic bones, handling quality, and the number

of primary wing feathers. With each of these characters the correlation with egg production is high. They range from 0.431 ± 0.048 to 0.0622 ± 0.037 . The anatomical characters, which include weight of fowl, width of pelvic arch, capacity depth of body, and length of keel, show no distinct correlation with annual egg production. The correlations range from 0.009 ± 0.060 to 0.210 ± 0.057 . The fact that there is such a distinct difference in the size of the correlations for the two classes of characters shows that the classification is not an arbitrary one but is based upon a real fundamental difference, and that egg production itself is largely a physiological rather than an anatomical character. It appears therefore that in common culling practice, much more importance should be attached to physiological than to anatomical characters.

Summary of Correlation for Characters studied.

Characters correlated	Correlation
Colour of shanks-annual egg production	- 0.622 \pm 0.037
Colour of beak	- 0.603 \pm 0.038
Miability of pubic bones	+ 0.472 \pm 0.046
Handling qualities	+ 0.431 \pm 0.048
Number of primary wing feathers moulted	+ 0.522 \pm 0.043
Body weight	+ 0.009 \pm 0.060
Width of pelvic arch - body weight	+ 0.216 \pm 0.057
Width of pelvic arch. annual egg production	+ 0.210 \pm 0.057
Ratio of width of pelvic arch, to weight	+ 0.178 \pm 0.058
Capacity - body weight	+ 0.468 \pm 0.047
Capacity - annual egg production	+ 0.093 \pm 0.059
Ratio of capacity to weight	+ 0.100 \pm 0.059
Depth of body - body weight	+ 0.645 \pm 0.035
Depth of body - annual egg production.	+ 0.174 \pm 0.058
Ratio of depth of body to weight	+ 0.149 \pm 0.058
Length of keel - body weight	+ 0.384 \pm 0.051
Length of keel - annual egg production	+ 0.208 \pm 0.057
Ratio of length of keel to weight	+ 0.120 \pm 0.059

F. D

85. Poultry Selection at the University of British Columbia, Canada.

LLOYD E. A. and ASMUNDSON V. S., Poultry Breeding at the University of British Columbia, *Scientific Agriculture, La Revue Agronomique canadienne*, Vol. II, No. 5, pp. 153-156, figs. 3; No. 199-202, figs. 3. Gardenvale, P. Q., 1922.

A large part of British Columbia is well suited to poultry-breeding on account of its uniform and temperate climate. Intensive poultry-rearing is practised in the coast district of the Pacific, the Lower Fraser Valley and the Island of Vancouver where the farms frequently have from 1 to 4 thousand birds, while many farmers get 90 % of their returns from their hens and the sale of eggs. For this reason, the creation of a breed of poultry with large egg-production is of the greatest importance for the agriculturist. Though the average egg-yield for the whole pro-

vince is 120 eggs per fowl per year, there are many pens in which the annual average is 160, some of the hens even producing 200 eggs the first year of laying.

The poultry-farm of the University of British Columbia was started in the autumn of 1918, and stocked with pens selected for large egg-production. The breeds were S. C. White Leghorn, White Wyandotte, Barred Plymouth Rock, and S. C. Rhode Island Red. Although the selection was chiefly directed to egg production, the characters and quality of the breeds were also taken into account.

The White Leghorns should lay 200 eggs, or more, the first year, and 150, or more, each of the two following years; the eggs are required to weigh at least 2 oz. (57 gm.) their shells must be very white and smooth. The hens must be fertile and produce vigorous chicks.

In the case of the different breeds it has been discovered by various matings which birds transmit their good qualities to their progeny. The power of cocks to transmit to their female offspring the laying qualities of the paternal grandmother has been confirmed. This capacity varies not only with the individual, but in the same cock according to the hens with which it is mated.

Some very promising broods of White Leghorns and of Wyandottes have already been obtained.

The Barred Plymouth Rock stock was obtained from the Oregon Agricultural College and consisted of well-shaped hens of medium size that had been selected for long duration of the egg-laying period. As they laid too small eggs at the University of British Columbia, they were mated to improve the blood with a cock of their own breed, but belonging to another pen, offspring of a hen that had laid 270 eggs weighing 737 gm. per dozen, during one year. In this way, the weight of the eggs was increased in the first generation by 85 gm. per dozen; the winter laying and the live-weight were also increased.

The selection will be continued in the same direction; only hens with 50 % fertility will be used for breeding purposes.

The S. C. Rhode Island Red stock came from the Massachusetts Agricultural College. The hens' annual production was 180 to 200 eggs. The cock was the offspring of a hen that had laid 296 eggs in 365 days. A good annual average egg production has been fixed in this breed. There is, however, some difficulty in combining the retention of the typical fine red colour of the eggs with a high egg yield.

F. D.

86 Control of Palpation of Laying Hens.

Concours de la Vie à la Campagne; (Contrôle de la Méthode de Palpation pour l'appréciation de l'aptitude des poules à la ponte *La Revue agricole*, Year 32, No. 11, p. 346. Paris, 1922.

The hens classified at the Paris Exhibition (February 1922) according to method of palpation, have since been under observation at the "Centre national d'expérimentation zootechnique de Vaulx-de-Cernay", in order to test their laying capacity. It has been shown that the hens which

held the first 10 places at the Exhibition, showed however an inherent irregularity as regards laying, as follows: 12 — 14 — 27 — 18 — 4 — 2 — 10 — 5 — 16 — 24 respectively (eggs laid from May 5 to September 10). These results are certainly questionable, as the laying capacity compared with palpation can only be estimated when dealing with hens of identical age, hatched and raised under the same conditions, having started to lay at the same period, and belonging to the same breed.

F. D.

87. Egg and Poultry Production and Consumption in Italy.

GANDOLFI, L. Relazione presentata al Congresso di Pollicoltura e Conigli-coltura tenutosi ad Asti il 27 ottobre 1922. *Bollettino degli Allevatori*, Year I, No 22, p. 2. Florence, 1922.

In the chief towns in Italy, there is an average yearly consumption per inhabitant of 200 eggs and 5 kg. poultry. With for a population of 40 millions this would mean 8 thousand million eggs and 200 million fowls each weighing 1 kg. Probably if these figures were reduced by one third, the estimate would be more correct.

During and after the war, the consumption greatly increased and absorbed an amount equal to that exported in pre-war years (about $\frac{1}{6}$ of the total production), and also the increased production.

The eggs are collected in the country and are taken or sent to the market centres by middle men. The average annual cost of production and sale price per dozen of new laid eggs for the years 1913-20 (inclusive) were respectively (in lire): 1 05 and 1 21, 1 06 and 1 22, 1 14 and 1 28; 1.40 and 1.44, 2.28 and 2.60; 5.00 and 5 77; 4 89 and 5 48, 6 00 and 6 63.

The preserved eggs (laid in lime or placed in cold storage) scarcely represent 1 % of the production. Italian eggs weigh on an average from 56 to 57 kg. per thousand, which is as much as French or Spanish eggs but are somewhat lighter than those from Denmark (59 to 60 kg. per thousand).

Though all restrictions on the export of poultry were removed in April 1922, the imports since that date have kept pace with, if not exceeded, the exports. The author emphasises the advisability of fattening table poultry.

F. D.

Pisciculture.

88. The Expediency of introducing Rainbow Trout into the Public Waters in Switzerland (1).

VOGLIA, M (Inspecteur général de la pêche). Faut-il introduire la truite arc-en-ciel dans les eaux publiques? *Bulletin suisse de pêche et de pisciculture*, Year 23, No 3, pp 35-37, No 4, pp. 53-55, No 5, pp. 74-76. Neuchâtel, 1922.

The introduction into public waters of new species of fish without the unanimous consent of the persons interested, is prohibited by law in nearly

(1) The rainbow or iridescent trout was imported into Europe in 1880. It was introduced into public waters in Italy frequently with little or no result, though it became acclimatised and propagated itself in the small lakes of the Emilian Apennines as it was apparently suited to their cold clear water — Felice Supino, *I pesci d'acqua dolce d'Italia*, p 57. Milan (Hoepf), 1916; R. 1921, No. 423. (Ed.)

all the cantons of Switzerland. The author, as a result of his long experience is, however, of opinion that an exception might be made in favour of the rainbow trout (*Salmo irideus*). For about 20 years, he has been engaged in breeding at a small piscicultural station in Neuchatel, or in fish ponds, many different kinds of foreign fish such as rainbow trout, American river charr (*Salmo fontinalis*), black perch, sun perch, catfish, etc. Of all these, the rainbow trout proved the most successful as it is hardy and not exacting as regards the nature of the water, or food supplied to it.

Rainbow trout should be introduced into the public waters as well as native trout and river and brook trout (*Trutta fario*), but not as a substitute for these species, in the lakes and rivers of Switzerland, although their waters have been much changed by industrial development, are still suitable for an intensive fishing industry owing to the fact that they are artificially restocked. Nine-tenths of the fish introduced are fry. The latter in the case of *Trutta fario*, are hatched in the piscicultural stations from January to March, and put into the waters at the end of winter or in early spring, when the snows being to melt and cause frequent floods, that are very injurious to young fish. The rainbow trout, on the other hand, spawns in Switzerland in March, and the fry hatch out in March-April and are ready for transferring to the waters at the end of April, or in May, which is a very favourable season; in consequence at least 50 % of the young fish survive.

The incubation troughs used from November to March for *Trutta fario* can be employed from March to May for the rainbow trout. As the apparatus thus does double service, the trout breeding stations are able to increase their output and complete the stocking of the rivers etc. by the introduction of a second batch of fry.

The rainbow trout is especially suited to waters not offering the conditions required by river trout, viz. it is adapted to rivers and streams with a straight course and steep banks affording no hiding places, or shelter for the fish, and to waters that attain a high temperature in summer (above 25° C.).

The rainbow trout is, however, not a formidable rival of the river trout; being of a less timid disposition it obtains its food more easily and is more readily caught than the latter, as the author's experiments have clearly proved, and thus saves the stock of river trout.

While the river trout frequently devour smaller individuals of their own species the rainbow trout do not and unless impelled by hunger, there is no fear of them destroying the river-trout.

As the two species spawn at such different times, there is little likelihood of any natural crossing taking place. Even under artificial conditions it is very difficult to obtain hybrids; those obtained are fine in appearance but apparently not fertile.

If the fish have lived in the same water, the flesh of both species is equally delicate.

In conclusion, the author sees no danger, and on the contrary possible advantages in the stocking of the public waters of Switzerland with rainbow trout, and strongly recommends their use for this purpose. F. D.

*Bee-Keeping.***89. Repeated Fertilisation in Bees.**

I. — Les bonnes reines pondeuses acceptent plusieurs accouplements. Elles sont plus prolifiques que celles à un seul. *L'Apiculteur*, Year 66, No. 11, pp. 361-363. Paris, 1922.

II. — NOIRET, M. Une reine peut-elle être fécondée plusieurs fois? *Ibid.*, pp. 363-365.

III. — JULIEN DE MAMERS, F. Capucin Miss. ap. (Addis Abeba). Au sujet de l'irregularité dans les marques de descendance de quelques reines. *Ibid.*, No. 12, pp. 403-404.

I and II. — The reports received from various apiaries in different countries confirm the observation made some years ago by GLAUDEX that the chief queen bees are fertilised more than once.

III. — That fertilisation of the queen bees occasionally takes place several times has been noted by Brother GIULIANO da MAMERS in the apiary of the Cappuccine Mission House in Addis-Abeba (Abyssinia).

The bees in the upper plateau in Abyssinia although slightly smaller resemble the black French type, whereas those in the desert are larger and yellow like the Italian bee. In the apiary at Addis-Abeba a swarm of yellow bees has been under observation. Sometimes the queen bees have produced black bees, yellow, and partly black and partly yellow bees. The author has noticed the production at a minute's interval of one black and one yellow worker. There is no doubt that they were produced by the same queen bee and from two eggs laid consecutively. The reason may be attributed to the fact that the queen bee had been fertilised both with a black and a yellow drone.

F. D.

Sericulture.

90 Studies in Inheritance in the Hybrid *Philosamia (Attacus) ricini* × *Ph. cynthia*.

MERRITT HAWKES, O. A. *Journal of Genetics*, Vol. 12, No. 2, pp. 112-135, bibliography Cambridge, 1922.

In a former article (*Journal of Genetics*, Vol. 7, pp. 135-154, 1918), the author described the larval characters of the male *Philosamia (Attacus) ricini* and the female *Ph. cynthia*.

Amongst the characters studied, the only pupal character of practical importance is the cocoon colour, the parent *Ph. ricini* having a pure white and *Ph. cynthia* a red-brown cocoon.

The F_1 cocoons were all intermediate in colour (fawn and pale brown). In F_2 there was no complete segregation, but a much greater range of colours than in F_1 , the colour varying from the characteristic red-brown of *Ph. cynthia* to a very light creamy white. In the succeeding generations, the same range of colour was continually reproduced, but white cocoons never appeared. The colours of the cocoons were not correlated with any other characteristic of larva or imago.

As to the sex-ratio, it is stated that in F_1 there is an excess of females and in F_2 an excess of males, and for the first 5 generations for every 100 females 71.8 — 144 — 158 — 145 — 158 males respectively.

F. D.

BIBLIOGRAPHICAL NOTES.

91. GAUNTLET, H. E. A Breeding Fallacy. An Examination of the Theories regarding "Throwing Back". *The Farmer's Weekly*, Vol. XXIII, No. 595, p 1937. Bloemfontein, 1922.

The author refutes the theory of impregnation. If a pure bred gives birth to a cross-bred, the impurity should be attributed to inherited impurities of the dam.

F. S.

92. LAPLAUD, M. and BRUNET. La valeur des pedigrees. *Revue de Zootechnie* No. 11, pp. 122-127, figs. 4. Paris, 1922.

In this article the authors show that the value of pedigrees should not be gauged by the herdbook, but rather on the intrinsic value of the animals. The herdbook should be considered, however, useful to judge the purity of the breeds to be sold to foreigners.

F. S.

93. ABDERHALDEN. Bisher unbekannte Nahrungsstoffe und ihre Bedeutung für die Ernährung. *Zeitschrift für Schweinezeitung*, Pt. 17, pp. 257-266; Pt. 18, pp. 275-276. Neudamm, 1922.

Report of the scientific research undertaken with reference to feeds and especially the vitamins and their functions.

F. D.

94. FOTICCHIA, N (Ispettore Generale Tecnico) La produzione zootecnica italiana. *Nuovi Annali del Ministero per l'Agricoltura*, Year II, No 2, pp 331-371. Roma, 1922.

The author describes the condition of stock-breeding in Italy, discusses its merits and defects, reports the progress made in North Italy, and the persistent deficiency in the quantity and quality of the products in Central and South Italy. The unsatisfactory state of affairs in the latter area is largely due to the lack of forage crops, and to many causes hindering the progress of agriculture: malaria, drought, "latifondo" (single ownership of vast estates), want of means of communication etc. The Ministry of Agriculture has rightly made great efforts to improve stock production in South Italy, but better co-ordination of the schemes is necessary to insure success.

L. V.

95. WHITE, A. H. Cow-testing and its Value. *The Agricultural Gazette of Canada*, Vol. IX, No 5, pp 378-380. Ottawa, 1922.

An Excellent example of the good results to be obtained where dairy records are used to guide the operations of breeding feeding and selection. At the end of the first year of testing in 1911, the average production of 14 cows in the herd in question was 5438 lb. milk; in 1921 with 15 cows the average production was 10 080 lb. milk and 371.3 lb. fat.

F. D.

96. Hunter Breeding on Wrong Lines. — *Live Stock Journal*, Vol. XCVI, No. 2532, p. 361. London, 1922.

Article on the future of hunter breeding in England and on the advantages and difficulties attached to the rearing of this breed. F. S.

97. PEASE, A. E. Hunter Breeding. *Live Stock Journal*, Vol. XCVI, No. 2533, p. 400. London, 1922.

The author considers that the cross Cleveland Bay with a pure stallion (Barb or Arab) gives the most satisfactory hunter breed. The mares can be used for farm work which will meet the cost of upkeep. F. S.

98. t'HOEN, H. De Paardenteelt in Nederlandsch-Indië. *Het Paard*, Year 28, Nos. 39, 40, 41 and 42. s'Gravenhage, 1922.

Horse raising in the Dutch Indies. Description of the following breeds:—Soemba, Javanaise, Preanger (Javanais × Parsau × Australien), Batak, Sumatra, Makassar and Savo. F. S.

99. SPOTTEL, A. and TANZER, E. Die mecanische Leistung des Schweineknöchens und deren Abhängigkeit von ausseren und inneren Faktoren. *Zeitschrift für Schweinezucht*, Pt. 15, pp. 225-231: Pts. 16, pp. 248-251, figs. 1. Neudamm, 1922.

Short but instructive report on the latest information concerning the effect of internal and external factors on the strength of the bones of the pig. F. D.

100. G. O. S. Breed points. *Live Stock Journal*, Vol. XCVI, No 2543, p 646. London, 1922.

List of characters which should be associated with the Gloucester Old Spot pig breed, the respective value of these characters and certain defects which lower their value.

The Society for the breeding of Gloucester Old Spots is responsible for this grading. F. S.

101. DE REGUIES, A. Razas porcinas explotadas en el Distrito Federal. Su alimentación y cuidado. *La Revista agrícola*, Vol. VII, No. 5, pp. 251-254. San Jacinto, D. F. Mexico, 1922.

There are in this district good industrial breeding establishments for the production of improved breeding stock, where Poland-China and Duroc Jersey pigs, which have proved the hardiest breeds, are reared. The Chester White has not done well. The animals are fed on by-products of cereals and grain, and also graze in lucerne fields; the methods used in breeding are fairly systematic. For home-breeding, in which the chief object is to obtain fat animals, the "criolla" race, sometimes more or less crossed with the White Yorkshire, is used. F. D.

102. BERNES-LASSERRE ED. (Secrétaire Général de la Fédération des Syndicats d'Élevage de Miélan). Le porc de Miélan. *Revue de Zootechnie*, No. 12, pp. 264-269, tables 2, figs. 4. Paris, 1922.

The Miélan pig is the result of mating a Gascon sow and a Yorkshire boar. The hybrid has inherited early maturity from its sire, and is vigorous, hardy and prolific like its dam. When fed on intensive fattening diet, this pig generally weighs 120 kg. when 7 months old. An animal weighing 200 kg. produces on an average: ham, 37.150 kg.; breast 18 kg.; shoulders 9.300 kg.; chine and palate 37.530 kg.; loins 33.150 kg.; fat 10.030 kg.; offal 13.100 kg.

The author makes some remarks also on the origin, habitat, selection, evolution, standard, capacity, and general measurements and value of pigs of the Miélan race. F. S.

103. SALAMAN, R. N. The Inheritance of Fur Types and Hair Characters in Rabbits. — *The Journal of Genetics*, Vol. 12, No. 2, pp. 179-207, figs. 24.

There are two distinct types of fur in the rabbit, viz.: 1) wild and short-coated, and 2) long-coated. There is no correlation between either of the two types and coat colour or other distinctive markings. There are three common types (small hair at skin level), square, round and oval. The first is recessive, the second is dominant to the square, and the oval is the normal dominant form in short coats. F. D.

104. La race de Bourbourg. *La Revue agricole*, Year 32, No. 12, pp. 384-385. Paris, 1922.

Result of a cross between native hens and Brahma and Cochín-China cocks introduced into the poultry yards of northern France in 1850.

Average weight of full-sized hens, 3.5 kg. well developed, short legs; medium size; colour white ermine, comb single; egg shells spotted, varying from yellow to dark red. Average quality flesh; good layers. F. D.

105. TANAKA, Y. (Department of Agriculture, University of Kyushu, Japan). Sex Linkage in the Silkworm *Journal of Genetics*, Vol. 12, No. 2, pp. 163-178, tables. 1, Cambridge, 1922.

The results obtained with the cross, "Giallo puro indigeno" (Italian univoltine) × "Okusa" (Japanese bivoltine), have led to the conclusion that the translucent factor in the "giallo puro indigeno" is sex-linked. There are at least eight translucent factors, one is sex linked and the others are independently transmitted so far as sex is concerned. Anyone of these factors is able to make the skin translucent. F. D.

106. PASQUALI, P. (Jefe de la Sección Química y Fisiología del Laboratorio Agronómico de la Inspección Nacional de Ganadería y Agricultura). Los forrajes secos o henos. *Republica Oriental del Uruguay, Ministerio de Industrias. Inspección nacional de Ganadería y Agricultura, Boletín No. 43*, pp. 33, figs. 9. Montevideo, 1922.

Methods employed in the preparation and storage of hay and a description of the most common hay crops. F. D.

107. A Milk Recording Scheme *The Farmer's Weekly*, Vol. XXIV, No. 603, p. 265 Bloemfontein, 1922.

Government Scheme for milk control in South Africa. F. S.

RURAL ECONOMICS

108 **The Amount of Live Stock on Large and Small Farms in Sweden.**

HOIGER I vad mån påverkas Kreaturskötselns omfattning av Jordbrukets storlek? *Kungl Landbruks-Akademiens Handlingar och Tidskrift*, No. 5, pp 361-376. graphic charts 4, tables 5. Stockholm, 1922

In 1919 a census of the domestic animals was made in Sweden from which it is possible to ascertain the head of live-stock on the small and large farms respectively. The agricultural farms were classified according to the area of land under cultivation, and the number of animals per 100 hectares of cropped land was estimated for each class of farm. The data obtained are plotted on chart I.

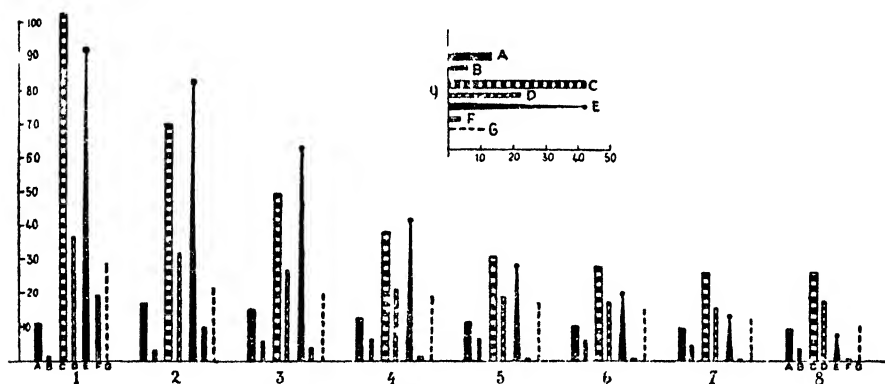


FIG 22 — Number of domestic animals
per 100 hectares of cultivated land in the various groups of farms

A = Adult horses	= Farms of 2 hectares
B = Colts and fillies	2 = " " 2-5 "
C = Cows	3 = " " 5-10 "
D = Calves	4 = " " 10-20 "
E = Sheep	5 = " " 20-30 "
F = Goats	6 = " " 30-50 "
G = Pigs	7 = " " 50-100 "
	8 = " " over-100 "

This chart shows that horses are most used and at least general expense, on the large farms.

Small farms are chiefly engaged in dairying, whereas on large farms stock-breeding is also important. On comparing the proportion between the live-stock and the cropped land of the different categories, it

is easily seen that stock breeding is much more intensive in areas where small holdings are the rule, than in districts where the land is in the hands of a few large proprietors.

In order, however, to realise the extent to which stock-breeding is practised on the large and small farm respectively, it is not enough to consider the total number of head reared, but a distinction must be drawn between the animals that can be put on the market and those required for work on the farm, as the surplus shows how far the country is self-supporting and what type of farming can best assure the food supply of the population. In Table I, stock-breeding is treated from this point of view; the number of animals has been reduced to units of production. The figures have been obtained by taking as a basis the number of calories produced annually by a cow giving 2 000 kg. of milk a year; the coefficients for the other animals being: ox and bull: 0.07; young cattle and calf; 0.165; sheep: 0.02; goats: 0.07; pig: 0.37; poultry: 0.003. For the milk cows of the plains of south and central Sweden, the coefficient has been raised to 1.5. The units of production thus determined are compared with the number of persons of all ages required to carry on the various forms of agricultural work

TABLE I — *Number of domestic animals, expressed as units of production, per 100 persons in South and Central Sweden.*

Area —	Plains —	Wooded Land —
1/2 hectare	57 6	49 1
2-5 hectares	79 5	66 7
5-10 "	107 0	86 2
10-20 "	141 4	107 7
20-30 "	158 8	117 2
30-50 "	167 8	113 9
50-100 "	138 7	98 9
Over 100 hectares	109 3	80 8
Average	120 7	81 6

This table shows that the number of live-stock per head is much less in the small farm, owing to the relatively large staff of persons employed, than it is in the large farm. The latter is not only superior in this respect to the small farm, but also to the large landed property.

P. S.

109. Cost of Wheat Production in Guadalajara (Spain).

HERCE, P. (Ingeniero Jefe del Servicio Agronómico). Coste de producción del trigo en Guadalajara (Spain). *Informe remitido a la Comisión provincial*, pp. 4-5. Guadalajara 1928.

The author estimates the net cost of wheat per metric quintal for the season 1921-1922 as follows.

Two types of landowner are represented: type A the agricultural landowner, who works the land himself and who possesses no equipment other than the ordinary plough and the "trillo de pedernales" (an implement

made from a wooden plank in which pieces of quartz are embedded) and drawn by two mules; Type B a small proprietor, who inherits a farm but does not actually work it himself; he owns 3 pairs of mules, one plough, one drilling machine, one reaper, one harrow, one: "trillo de pedernales", and one winnow, and also a waggon. Both cases refer to non-irrigated land

The author calculates separately the costs of upkeep of a pair of mules during the fallow period and during the cultivation period. Allowance is made for the value of work done, and this consequently varies in the two cases

Supposing that the cost price of the animals be 500 *pesetas* and that they are resold at the end of 12 years for 1000 *pesetas*, the total expenses at the close of the year amount to 3831.45 *pesetas* from which may be deducted 97.7 quintals for farmyard manure at 1.40 *peseta* per quintal, leaving a sum total of 3694.60 *pesetas*. Estimating 280 working days per

year, this works out to $\frac{3694.60}{280} = 13.20$ *pesetas* + 4 *pesetas* per day

for the driver = 17.20 *pesetas*

In the same way, the author estimates as value for the working day, season 1921-22, 14.75 *pesetas*.

Consequently the profit and loss accounts are calculated thus.

	Expenses	By products	Net cost
	<i>Pesetas</i>	<i>Pesetas</i>	<i>Pesetas</i>
1st year (fallow)	167.60	1.70	165.90
2nd year (wheat)	289.65	40.15	249.50
Total	457.25	41.75	415.40

The average yield being estimated at 7.51 quintals per hectare, the cost per quintal is $\frac{415.40}{7.51} = 55.30$ *pesetas*

For type B, the author considers apart, the cost of drilling, harvesting, transport, and winnowing, and states the profit and loss accounts per hectare as follows:

	Expenses	By products	Net cost
	<i>pesetas</i>	<i>pesetas</i>	<i>pesetas</i>
1st year (fallow)	167.70	1.70	166.00
2nd year (wheat)	238.45	52.30	186.15
Total	406.15	54.00	352.15

As the yield averages 10 quintals per hectare, if care is taken, the net cost per metric quintal is $\frac{352.15}{10} = 35.20$ *pesetas*.

The author has estimated the market price which should be obtained in each case so that the farmer may cover his expenses. For instance, suppose that for type A, the family consists of husband, wife and 4 children of whom two are capable of helping on the farm. Taking into account the characteristic economic instincts of the Spanish peasant, the annual household expenses are estimated at a minimum of 2000 *pesetas*.

Two mules are sufficient to work 48 hectares, on the "año y vez" system (1 year fallow, 1 year cultivated). This corresponds to 24 hectares fallow and 24 cropped. The working days are included in this estimate, as in this case, the work is carried out entirely by the peasant and family. This works out to a cost of 94.65 *pesetas* per hectare, and 2274 *pesetas* per 24 hectares. As the family expenses are estimated at 2000 *pesetas* the 274 *pesetas* loss is evident. One hectare gives a yield of 7.51 quintals, and 24 ha gives 180.24 qx. The following calculation is therefore evident:

$\frac{274}{180.24} = 1.52$ *peseta*. As the net cost for type A is 55.30 *pesetas*, the final total is 53.78 *pesetas*, the sum which the labourer belonging to this group should obtain for his wheat to meet the family requirements.

For type B, as the landowner does not work on the farm he is not included in the calculation. Estimating the cost of upkeep of family at a minimum of 6000 *pesetas* per annum and the cropped area at 72 hectares, giving an average yield of 10 qx per ha. the sale price should exceed the net cost $\frac{6000}{720} = 8.25$ *pesetas*. The net cost being 35.20 *pesetas*, the sale price ought to be 43.55 *pesetas*.

A comparison between the present prices indicates that wheat production is ruinous. To facilitate matters, the author recommends that the farmer should abandon present methods, and as in the case of other industries, adopt the improved technical methods rather than allow his land to go out of cultivation and become valueless. The conservative spirit is so often the cause of present day difficulties in farm work.

It is stated that the cost price can be decreased by increasing the yield, otherwise the expenses increase in the same proportion, or rather the expenses decrease without lowering the yield. With this in view, the author advises that *a well chosen crop be sown on the double row system on non irrigated land*. The practice of ploughing 3 or 4 times on fallow land should be given up, as this is unsuitable for weather conditions in the province of Guadalajara. Sowings should be made with a drill, which would economise seed, and in double lines allowing only sufficient space between the lines for the cultivation.

The author is confident that by improved methods it will be possible to obtain 12 qx. per ha, and the net cost will be 29.35 *pesetas*. As the decrease in expenses is 30 %, or allowing only 20 %, the net cost will be 23.48 *pesetas*. By adding 8.35 *pesetas* margin, the sale price should amount to 31.83 *pesetas*, which would allow of a profit.

E. C.

FARM ENGINEERING

110 Automatic Uncoupling Apparatus for Tractors.

DESSAISAIX, P. Attelage à décrochage automatique pour tracteur *Journal d'Agriculture Pratique*, Year 86, No 50, pp 500-502. Paris, December 1922

A tractor stops abruptly when it requires from its engine any, even momentary, traction-force above a certain limit, while if the engine is powerful, and exerts a heavy pressure on the soil by means of its driving wheels, which, as a result of revolving upon themselves, become buried in a light soil, and rear up on heavy land upsetting the tractor if the fore-carriage is not sufficiently loaded.

To remedy these defects, RINGELMANN advises that the weight should be carefully distributed on flat ground, two thirds falling upon the driving-wheel or wheels, and one upon the steering wheel or wheels.

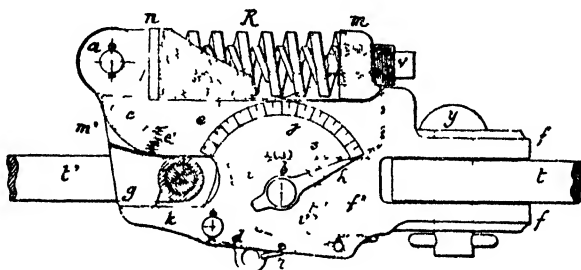


FIG. 23. — Boichot's Automatic Uncoupling Apparatus.

The serious accidents that have befallen mechanics have suggested the adoption of various safety appliances for preventing the engine rising when the tractor becomes slightly inclined either as regards its longitudinal, or transverse axis. We may mention Mr. EMILE FRUILLETTE's automatic safety apparatus and others designed in the United States. In many agricultural machines, the tractor is attached to the plough by means of a wooden peg which wears through and breaks when the strain reaches the breaking limit. As a rule however mechanics neglect this danger-signal and become vexed at the trouble involved in replacing the peg that breaks more or less easily according to the wood of which it is made, but yet serves as a useful warning, and substitute for it a metal bolt, or iron pin. The bolt does not break, but makes the tractor sink into the soil, or rear up, thus causing loss of time and considerable damage. The old complicated arrangements for preventing these inconveniences are no longer used, but have been replaced by an apparatus provided with springs and capable of automatically uncoupling the tractor when the traction force exceeds a certain limit that can be adjusted at will. One of these new uncoupling devices has been recently designed by HENRY BOICHOT

(fig. 23). Part of the apparatus is joined to the coupling-bar t of the tractor (or to the wire-rope of the cable system) by means of the fork f and the bolt y ; the portion mm' is attached; to the cylinder a that rests upon n above the springs R working by compression; to the incompletely toothed-wheel b and to the axle of the clutch d which is kept in place by the spring r .

The springs R (of which the compression can be regulated by means of the screw v), rest on the piece m , which is attached to the part that can change its position as regards the axle y to an extent depending upon the traction-force exerted.

This movable portion mm' which is provided below with hook g of special shape bears the axle c of a break e held by a small spring e' , the hook g serves to keep upon the guide-block k , which is connected with the clutch d and the fork f , the axle x of the shaft t' that is attached to the machine drawn by the tractor.

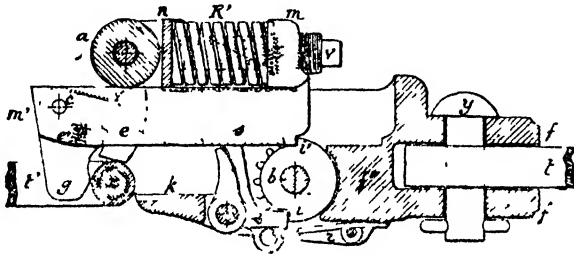


FIG. 24. — Position of the various parts of the Apparatus

In order that the traction force may not exceed a certain limit, the movable piece mm' oscillates on the other parts at a greater or less distance from the axles x and y according to the movement of the springs R and the extent to which they are compressed, but the piece x remains fixed, being held in position by the hook g and the patten k .

By means of this displacement, a toothed-bar connected with the movable piece mm' , engages with the wheel b causing it to revolve in such a manner that an index hand b fixed in its axle, and moving over a graduated arc gives an idea of the traction-force required by the agricultural machine attached at t' .

When the traction-force becomes excessive the machine is uncoupled automatically, and the various pieces take up the positions shown in fig. II.

The spring R having been compressed to R' , the axle x has gone beyond the limits of the patten k upon which it rested, and is impelled upwards towards the base of the break e , which is pushed upwards by the cylinder a , so that it compresses the small recall spring e , while at the same moment, the axle x and the shaft t' separate from the machine connected by the traction-bolt y .

At the moment of uncoupling, all the parts connected with the tractor t remain in position in order to make it easier to remove the machine. All that is necessary afterwards, is to clean off the soil from the plough, or other implement, so as to decrease the resistance, and then make the tractor

move backwards. The pieces remain in the following position : the wheel *b* carries two flanges *i* and *i'*; in the act of uncoupling, the flange *i* allows the lower part of the clutch *d* to rise by the action of the spring *r* which hinders the rotation of the wheel *b*, while the other flange *i* comes against the hook of the movable part *mm'* at the front end of the toothed-bar *s* and the wheel *b* is engaged by the clutch *d* and is slightly pushed towards the axle, *y* thus grazing the fixed part *f'* of the frame and acting as a drag.

In order to couple the machine, the axle *x* is put in its place and the tractor is made to move back; this causes the axle to press on the upper clutch of the clutch *d*; this revolves releasing the flange *i* and setting free the wheel *b*, while the movable portion *mm'* takes up its original position through the action of the spring *R*.

The BOICHOT apparatus is made for a maximum force of 1200 kg. and contains two sets of parallel springs. It is 0.29 m. long, 0.11 wide, 0.15 m. high; its total weight is 9.895 kg. E. P.

III. Electric Windlass with Speed-Reducing Anchoring Pole.

SOURRISSEAU, T. H. (Director of the Toulouse Experiment Station for Agricultural Machines). Un treuil électrique à flèche d'ancrage amortisseur. *Journal d'Agriculture pratique*, Vol. 38, No. 46, pp. 418-421; *Ibidem*, No. 47, pp. 438-440. November, 1922, *Ibidem*, No. 48, pp. 459-461, December 1922.

The Agricultural authorities of the South-West district decided two years ago to organise public demonstrations of electric-ploughing and the use of electricity on the farm belonging to the District Agricultural College at Ondes (Upper Garonne). The author was asked to study the question of the installation of electric force and was entrusted with the electric ploughing experiments to be carried out from October 12 to 19, 1921.

Many interesting experiments were made in electric ploughing by means of cable-traction with windlasses.

The Ondes plant consisted of two electric windlasses T_1 and T_2 (fig. 25) moving on 2 special field-lorries. They alternately pulled a balance plough by means of a cable made of steel strands which wound itself round the drums of the windlasses. The engine is supplied with the necessary electric force by a flexible triple-conducting cable attached to the electric line that runs along the end of the field.

Of the windlasses used in the experiment, mention is made of the ESTRADÉ windlasses of the Carcassonne Electric Motor-Cultivation Society, noted for their automatic anchorage appliance.

ESTRADÉ Windlasses of the Electric Motor-Cultivation Society. — The two windlasses T_1 and T_2 work on the same principle and draw alternately a three-furrow balance plough. Their chief characteristics are as follows :

Windlass T_1 (1919 type). Total weight, 5000 kg., three-phase, asynchronous engine, 500 volts, 50 HP, frame mounted on 4 wheels two of which form the fore-carriage, while the other two are the driving-wheels for moving the carriage as soon as the furrow is turned. The drum round

which the cable is wound has a horizontal axle and is regulated by gear for reducing the speed.

Windlass T_2 (1921 type). Total weight of windlass 3000 kg., three-phase, asynchronous engine, 500 volts, 35 HP; frame mounted on 4 wheels of 1 metre in diameter, two of which form the fore-carriage and the other two act as driving-wheels as in windlass T_1 .

The dimensions of the drum are: diameter of jaw-socket 1.10 m.; internal diameter 0.80; width 0.13 m.

The windlass is transported to the field by draught animals.

Automatic anchorage, ESTRADÉ system.

The rope C passes directly from the drum T, over the pulley-guide P which has a deep groove and a large diameter; it is borne on the end of a movable pole F (table VII, fig. 26). The movable pole F articulated with the frame is the distinguishing feature of the apparatus. The pole is constantly impelled into an erect position by two sliding pistons in two cylinders containing nitrogen; glycerine separates the pistons from the nitrogen. The lowering of the pole caused by traction compresses the nitrogen, which expands when the machine is at rest. The effect of these two forces at once produces a state of equilibrium in the pole, and the height of the extremity of the pole above the soil varies with the traction-force required by the plough. As the traction force increases, this height decreases and *vice-versa*, hence the pole is very effective in diminishing a sudden increase of traction during ploughing.

The two wheels situated on the traction side are provided with cutting disks made with iron at the angle which penetrates into the ground. These disks must be placed inside instead of outside the wheel-rim. The iron at the corner sinks into the soil under the weight of the windlass, and the soil becomes hardened owing to the compression of the prism of soil held between the iron at the corner and the wheel rim. With the movable pole F, ESTRADÉ uses the resultant R of the weight P of the tractor and of the traction T, exerted on the cable to fix the windlasses in the soil; in consequence these can be light without any fear of slipping.

If there is no traction, the weight P of the windlass is applied to the centre of gravity, and distributed equally to each of the wheels.

If traction is then exerted, and the movable pole F is in the position

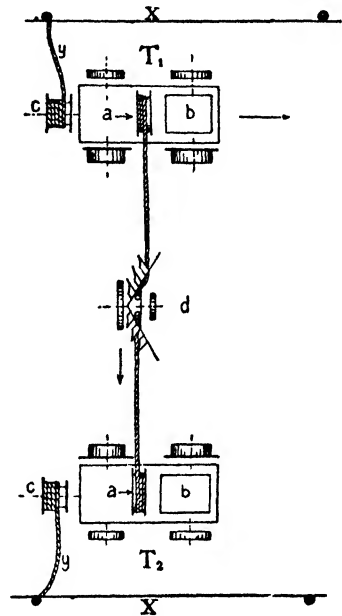


FIG. 25.

Plan of Plant with two electrical windlasses T_1 and T_2 .

a = drum; b = motor; y = flexible cable; c = winder; x = electrical cable; d = balance plough

shown in fig. 27, the resultant R of the impulse of traction T and of the weight P affects the rims of the two wheels situated at the side; the traction is applied at point S ; from this time, the weight falls only on the abovementioned two wheels, each of which bears half the weight.

Let it now be supposed that the traction force is increased and exceeds the value T_2 . The new resultant R_1 , falling outside the plane of support, would upset the windlass, were it not to liberate the pole which is affected by the new value T_2 , and takes up another position causing the resultant R_2 to pass again by the point J , thus insuring the balance of the machine.

However much the value of the traction force may increase, the resultant may be said to remain attached to the point J , thus causing the wheel rim to be continually more pressed in the direction of the resultant and compressing the prism of soil Jmr .

In the case of an ordinary windlass, if we call its weight P and the resultant of the horizontal traction-force to which it is subjected T , the tangent of the angle formed by the resultant with the vertical is given by $\frac{T}{P}$ (fig. 28). Since the weight of the windlass is a constant, when T increases, the angle and its tangent also increase; until $\tan a$ has reached the value of the friction-coefficient f the rim of the wheel slips. At this moment, $T = fp$, and since f the friction-coefficient of the outer wheel rims in contact with the soil never exceeds 0.50, it follows that the traction-force to which the cable is subjected can never exceed the value $\frac{p}{2}$ without skidding taking place.

As we have already seen, by means of the ESTRADÉ anchoring pole, the resultant always passes by the edge J of the outer rims of the two wheels supporting the total weight P during the whole course of the work, while the other two are only applied to the ground.

Ler AB (fig. 29) be the rims of the wheels, AC the vertical jaw-socket of the angle-iron, AD the direction of the resultant R of the weight P and of the traction force T ; a the angle of this resultant with the vertical, then as we have seen, $\tan a = \frac{T}{P}$ or in the case of an ordinary windlass, skidding would take place even when $\frac{T}{P} = 0.50$. In the apparatus of the "Société d'Electromotoculture" however, skidding takes place along the plane CB that makes with the horizontal an angle b of which the tangent is $\frac{CA}{AC}$.

By the breaking up of R into its two components T_1 in the direction CB , and P_1 in the normal direction, we have the result shown in fig. 29. $T_1 = P' \tan(a-b)$ which gives $T_1 = \tan(a-b)$. It is seen that T_1 is less than T and P_1 is larger than P so that the arrangement adopted causes a decrease in the force tending to cause the skidding of the windlass and increases the force tending to keep it firm. If we call c the friction angle of soil against soil, the skidding movement according to CB can only take place when $\tan(a-b) = \tan c$, or when $a = b + c$.

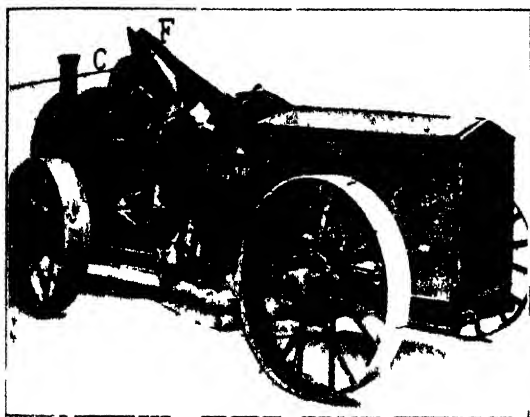


FIG 6

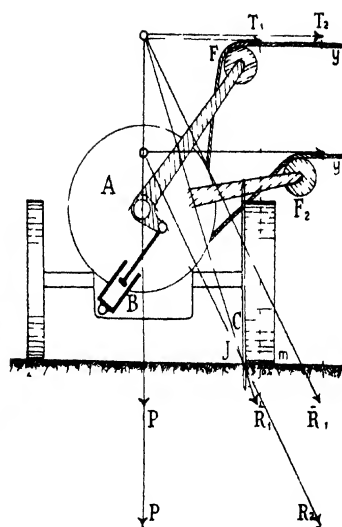
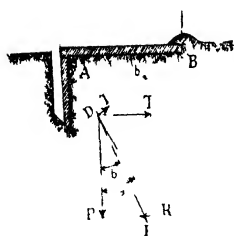


FIG 27



FIG 28



FIG

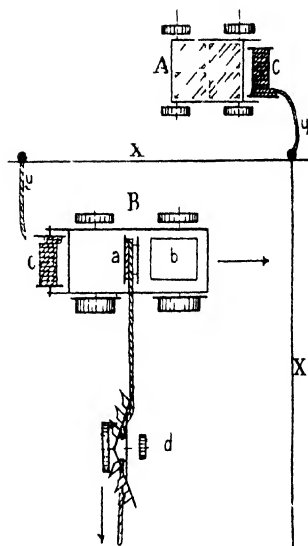


FIG 30

FIG 1. 1-stride windlass made by the "Societe d'Electromotoculture" ready for transport by rail. FIG 2. Stopper, this is fixed to the 1-stride windlass. FIGS 3 and 4. Method of work of the cutting disks affixed to the runs of the windlass wheels. FIG 30. A — storage battery, y = flexible cable, X — line of continuous current, a — drum, b — motor, d — balance plough.

At this moment, the traction-force exerted on the windlass would be

(1) $T = P \tan(b + c)$ and since $\tan(b + c) = \frac{\tan b + \tan c}{1 - \tan b \tan c}$ (1) will become $T = P \frac{\tan b + \tan c}{\tan b \tan c}$.

In the windlass used in the experiment $\frac{AC}{AB} = \tan b = \frac{1}{2}$ from which we get $T = P \frac{1 + 2 \tan c}{2 \tan c}$.

The friction-coefficient of soil against soil is $\frac{2}{3}$ in ordinary soil, and exceptionally = 1. According as one or other of these values is taken, we have ;

$$\text{for } \tan c = \frac{2}{3}, T = 1.75 P.$$

$$\text{for } \tan c = 1, T = 3 P.$$

The conclusions of this technical study have been confirmed by the practical results, in fact, the ratio $\frac{T}{P}$ in the windlasses of the Société d'Electromotoculture " has become 1.5.

Tests. — The alluvial soil of Garonne is a siliceous clay ; it had been rendered more compact by the exceptional drought. The traction-force required to plough dm² of furrows 0.22 m. deep and 0.90 m. broad was on an average 86 kg., and at some points, 113 kg.; the speed of the plough was 1.10 m. per 1". The average consumption per hectare was 77 kilowatt-hours.

It takes about 3 hours to plough a hectare. These light windlasses are suitable for medium sized and large farms. For ordinary ploughing, a three-furrow plough is used, for vineyard cultivation or hoed crops, gang-ploughs or cultivators adapted to cable-traction should be employed.

With a view to making the construction and handling of this windlass easier, and reducing its cost, ESTRADÉ has altered it somewhat by dividing it into two separate parts, one for carrying the traction-cable and the other for transporting the apparatus. The first part is driven by an engine developing 35 HP and running at 1500 revolutions, in short circuit, thus doing away with the rheostat. The average speed of the traction cable is 1.10 m. per 1", though another speed of 0.30 m. is provided for deep ploughing. The second part has an engine of 5 HP running at 1500 revolutions in short circuit ; it acts on the hinder axle in order to alter the position of the windlass.

It is well to use storage batteries to work these windlasses (fig. 30), as they can be cheaply charged at night, or during the hours of the day when there is less consumption of electric energy (for instance, in France, at a cost of 5-20 centimes per kilowatt-hour). This system is widely adopted in England, Germany and Switzerland.

E. P.

AGRICULTURAL INDUSTRIES

SYNTHETIC ARTICLES

112. Plant Resources for Motor Fuel.

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- IV. BOYD, T. A. Motor Fuel from Vegetation. *The Journal of Industrial and Engineering Chemistry*, Vol. 13, No. 9, pp. 836-841. figs. 6. New York, 1921.
- V. JUMELLE H. (Professeur à la Faculté des Sciences de Marseille et Directeur du Musée Colonial). Les huiles végétales, carburant colonial. *L'Agronomie coloniale*, Year 7, No. 59, pp. 345-354. Paris, 1922.
- VI. LUC, M. (Ingénieur de 1^{ère} classe des travaux d'agriculture aux colonies) Outillage colonial agricole et main-d'œuvre). *Ibid.*, pp. 361-367. Paris, 1922.
- VII. FLOCKTON, B. P. Palm Oil Production. *Tropical Life*, Vol. XVIII, No. 3, p. 39. London, 1922.
- VIII. Oil for Semi-Diesel Engine for Rubber and other Estates. *Ibid.*, pp. 40-41.
- IX. Palm Oil as Motor Fuel. *Bulletin of the Imperial Institute*, No. 3, pp. 515-516. London, 1921.

The ever increasing use of internal combustion engines for motor and other purposes causes a corresponding demand for fuel. It becomes necessary therefore to take stock of every possible source of supply, and the question of utilisation of vegetation and plant residues is of considerable technical and economic importance. The gradual depletion of crude petroleum accentuates this fact.

I. SOURCES OF INDUSTRIAL ALCOHOL.

Experiments on a large scale have been in progress in the United States, Philippines, Cuba, etc. to ascertain the comparative values of alcohol from various sources, and it is estimated that the Nipa palm (*Nipa fruticans* Wurm.) and blackstrap molasses offer the cheapest and most easily manipulated and valuable sources of alcohol. As a motor fuel, especially for internal combustion engines (III-IV), alcohol possesses certain outstanding advantages: 1) the combustion is marked by cleanliness and freedom from any carbon deposit; 2) alcohol is "softer" than benzene and the running of the engine is smoother; 3) alcohol stands high initial compressions without knocking and permits the use of available

horse-power of a definite size of motor to be greater than when petrol is employed ; 4) lubrication difficulties are not likely to occur ; 5) so far, no corrosion has appeared in the valves and no acids in the exhaust. Difficulties such as the low heating valve etc. will be overcome in due course if certain practical points are observed

- 1) alcohol is more efficient in engines of low piston and long stroke ;
- 2) the circulating water should be kept as hot as possible
- 3) the inlet air should be well preheated ; alcohol will not vaporise at ordinary temperatures ;
- 4) high cylinder temperatures are required ;
- 5) the jet orifice should be enlarged so as to increase the fuel supply about 50 % ;
- 6) metal carburettors should be used.

The chemical and physical properties of alcohol from the motor fuel standpoint, should have a direct bearing on the old type of high-compression low speed engine, suitable for constant use of alcohols.

Up till now the alcohol mixtures have given better results than alcohol alone with its calorific value of 7237.9, e. g. natalite (prepared in S. Africa) (55 % rectified alcohol, 44.9 ether and 0.1 % ammonia) and a new mixture used in Hawaii (55.55 % alcohol, 42.78 % ether 1.11 % kerosene, and 0.56 % pyridine) have proved very successful ; and compares favourably with the alcohol + benzene mixture used in Europe. The comparison tests made by H. I. COLE (1) with natalite etc. in the Philippines demonstrates the advantages over shell petrol. It is stated by H. COLE that a motor fuel should contain at least 40 % ether.

As regards estimated cost, a clear statement is given of the cost of an alcohol motor fuel plant producing 1000 gallons per day (these figures are derived from the result of practical experience in the erection and operation of numerous distilling plants in the Philippines). The estimated daily operating cost of alcohol motor fuel plant producing 1000 gallons per day is given as \$25 labour, + \$83 fuel, + \$30.29 interest, depreciation etc. (1).

In this case, cane molasses was the sole source of alcohol, the present annual supply of which in the Philippines amounts to about 7 800 000 galls (2).

These figures give a general idea of the cost and value of molasses as fuel.

(I-II). — The Nipa palm (*Nipa fruticans*) sap is by far the most important and cheapest source of alcohol, in addition to the fact that this palm grows on areas otherwise unproductive, and as the sap is drawn from the inflorescence stalk near the ground, the necessity for climbing is obviated. The larger proportion of alcohol has however, been consumed in the form of spirits, and it is only recently that the industrial

(1) Equipment figures and supply costs based on current prices at San Francisco, California.

(2) For comparison of costs between the use of alcohol and petrol in England see *Power Alcohol*, p. 116, 1922

value as motor fuel has been brought to the fore. It is estimated that on an average, the daily flow from one stalk is about 1 pint, the total yield during the period of flow being about 9 to 10 gallons. Assuming that 300 plants per acre are tapped each season, the annual yield of "tuba" may be taken as 2700 gallons per acre, and this works out to a yield of about 170 to 200 gallons of 95 % alcohol per acre (1).

Full details as to the cultivation, harvesting, and distillation are to be obtained (I-II-III), but quite apart from recognised cultural details it is of interest to note that spontaneous fermentation occurs before the sap arrives at the distillery; the complete fermentation, however, requires 30 hours to 3 days, but to avoid change of alcohol to acetic acid most of the large distilleries now ferment a mixture of nipa and molasses (I).

At present the Nipa palm is most widely distributed in the Philippines and in British North Borneo, the acreage being estimated at 100 000 and 300 000 respectively (III).

Apart from molasses and nipa sap, the manufacture of alcohol from waste wood (a yield of from 15 to 25 gallons of alcohol per ton of dry wood), and from foodstuffs such as cereals tubers, roots, etc. is being studied (2), but it is essential that investigations should be carried out on material other than foodstuffs, e. g. other species of palm (e. g. *Macrorhynchia* spp., *Metroxylon* spp., *Xanthorrhoea* spp., etc.

From a general standpoint, G. MONIER WILLIAMS (III)* gives a comprehensive survey of the various aspects chemical, physical, biological, engineering and economic of the alcohol fuel question, and he claims that power alcohol has an undoubted future, provided the industry is organised and developed on sound lines. The more important, possible raw materials for alcohol production, are compared with respect to their yields and availability and several economic factors bearing on the power alcohol question are discussed. An account is given of the various processes for manufacturing alcohol from cellulose.

Results of numerous engine tests carried out by different investigators with alcohol in comparison with hydro-carbon fuels are given, and the value of various alcohol mixtures as motor fuels.

The increasing demand for alcohol as a substitute for petrol for power purposes, particularly in tropical countries, renders the consideration of plant resources of evident importance.

II. *Vegetable Oils for Combustion Engines* (3). (VII-VIII). With the high price of crude petrol in the colonies, and the danger of using

(1) The yield of sugar from the Nipa palm is considered from another standpoint. See *R* Sept 1921, No 916. The article in the *Bulletin of the Imperial Institute* Vol XX, No 3, 1922, pp 321-324 (The Nipa Palm as a Source of Sugar) and *The Philippine Journal of Science*, XX, No 1, pp 45-54 (Recent Improvements in Nipa-Sugar Manufacture) deals in detail with this question.

(2) See *R* July, 1921, No. 764.

* G W MONIER WILLIAMS M A Ph D. *Power Alcohol: Its Production and utilisation* London, Henry Frowde and Hodder Stoughton, 1922, Price 21 s.

(3) See *R* Nov, 1921, No 1169 (*Fd*).

light volatile and inflammable oils in a hot climate, attention has been directed to natural resources amongst vegetable oils in order to cope with the demands of modern industry *in situ*.

At the last "Congrès des Combustibles liquides" held in Paris, October 1922, the question was thoroughly discussed and it has been stated since that without any doubt the vegetable oils, fluid or solid, are peculiarly adaptable as motor fuel for internal combustion engines (type Diesel and semi-Diesel) (VIII-IX) (1). With reference to the experiments made with semi-Diesel engines it is interesting to note the satisfactory results obtained in Europe, with palm oil with hardly any structural alteration. An examples given of a 50 h. p. engine run on palm oil at a fuel consumption of 0.67 lb. per b. h. p. hour. No trouble was found but at 300 revolutions per minute the power was reduced from 50 h. p. to 44 h. p. After a run of 6 hours duration the piston and cylinder were free from carbonaceous deposit.

The calorific value of vegetable oils is comparatively high. According to LEWKOWITSH, the calorific value of groundnut oil equals 9412 measured on volume, and 9427 (constant compression). An average of 9450 calories may be accepted for vegetable oils in general, and this compares favourably with other oils employed. e. g. naphthaline (9600) and tar oils (8800). The vegetable oils possess the distinct advantage of a viscosity $4\frac{1}{2}$ times less than that of heavy oils.

The possibility of corrosion owing to the 50 % acidity in palm oil for example, an oil which has been regarded with favour recently, has been disproved by experiment.

Experiments made in Brussels in January 1921 have demonstrated the adaptability of vegetable oils to motors hitherto run on heavy oils, and the absence of carbonaceous deposits when combustion is complete.

Palm oil remains liquid even after a stop of a $\frac{1}{4}$ hour; and no supplement is required to start the engine.

The palm oil analysed and tested which has so far given the most satisfactory results possesses the following properties:

Specific Gravity at 15° C	912.2
Viscosity Engler	3.28
Viscosity Engler. at 100° C	1.10
Spontaneous ignition temperature	405° C.
Combustion point (Ordinary)	308° C
Vapours point of inflammability	270° C
Moisture %	2.40
Impurities	2.10
Net calorific value	9.33

The question of acidity has not been given much attention, especially as recent experiments have shown that even when acidity is marked, the deleterious effect is negligible.

In countries where transport is a constant source of difficulty, owing to the tsetse fly, and the consequent impracticability of stock raising,

(1, See Swedish motor fuel *Svensk Pappers Trid*, 24 (1921), p. 69.

e. g. in Africa, the possibilities of facilitating transport and of using oils obtained *in situ* for motorculture on cultivated land where time is often very limited, is an all important question. The fact that pre-war prices for crude petrol are not likely to recur accentuates this importance.

The improvement of methods of depericarping and cracking palm fruits should not be overlooked in connected with the development of the vegetable oil industry (See bibliography); an interesting comparison between modern and native methods is given by FLOCKTON (VII).

Up to the present investigations have been centred on palm oil but it is to be hoped that all possible utilisable vegetable oils obtainable in tropical countries, should be given equal attention, taking into account the distinct variation in characteristics of different oils.

The following is a list of publications connected with this subject:

Alcohol fuel.

- 1) Fuel for Motor Transport. *Fuel Research Board London*, 1921.
- 2) LIGHTFOOT. Power Alcohol. *Bulletin of Australian Institute of Science and Industry*. No. 20, 1921.
- 3) Production of 95-97 % alcohol for motor fuel. *International Sugar Journal*, No. 23 (1921), p. 513.
- 4) Power alcohol in the United Kingdom. *Ibid.*, p. 434.
- 5) Swedish Motor fuel. *Svensk Pappers Tid.*, 24 (1921), p. 69.
- 6) Motor fuel from Philippine waste products. *Trans. Pacific*. No. 6 (1922). p. 69.
- 7) WINDISCH and RUDIGER. *Zeitsch. für Spiritus-Industrie* (1920), No. 43, p. 203, 292, 300.

Molasses.

- 1) APPELL, G. M. Alcohol production from molasses. *Chem. Age N. Y.* 29 (1921) p. 53.
- 2) MAGNÉ. Pamphlet on Manufacture of alcohol from molasses and cane juice. *New Orleans. La. U. S. A.*
- 3) TILLERY, R. G. Use of alcohol made from fine molasses as motor power in Cuba. *Louisiana Planter*, 56 (1921), p. 142.
- 4) HELDERMAN and KHARNOVSKY. Over den invloed van colloïden op de viscositeit van onge Java, net suikermolassen. *Mededeelingen van het proefstation voor de Java Suikerindustrie. Chemische Serie* 1921. Nos 3-10.

Vegetable oils.

- 1) Extracts from the Report of the "Congrès International des combustibles liquides (Paris) 15 Oct. 1922". MAILHE. A. Preparation du pétrol à l'aide d'huiles végétales. MATHOT R. F. La traction mécanique dans les colonies. CHARLES. Les huiles végétales et leurs applications. YVES HENRY. L'huile végétale carburant colonial. LUC. L'utilisation des matières à huiles végétales à Madagascar en A. O. F. et au Cameroun.
- 2) CHALMERS T. W. Production and Treatment of Vegetable Oils. London, Constable (1920).
- 3) Oleaginous Products and Vegetable Oils. *Statistical Survey of Production and Trade (International Institute of Agriculture Bureau of Statistics)* 1923.

- 4) MITZAKIS. M. Oil Encyclopedia. London, Chapman and Hall, 1922.
- 5) Oleos Vegetaes Brasileiros. *Ministerio da Agricultura : Rio de Janeiro* 1922.
- 6) MARTIN, G. Oils. Fats and Waxes. London (Crosby, Lockwood and Son), 1920.
- 7) Le moteur à Huile de Palme. *Bulletin des Matières grasses*, 1921. No. 1.
- 8) Huile 'de Palme, dans les Moteurs aux colonies. *Agronomie Coloniale*, 6^e année, août 1921, No. 40, p. 157.

M. L. Y. and P. C.

Plant Products.

113. Hybrid Vines and their Wine Production.

VINCENS, J. (Ingénieur agronome Directeur de la Station œnologique et du Laboratoire Régional Agricole de Toulouse). Contributions à l'étude des hybrides de la vigne. *Revue de Viticulture*, Year 29, Vol LVII, Nos. 1474 and 1475, pp. 197-202 and 216-221, figs 8, tables 2. Paris, 1922.

The article first deals with general facts concerning vine hybrids. The most interesting section, however, refers to the results obtained with the tasting tests of red and white wines. These tests were made with wines prepared at the Station with grapes sent there direct.

The author considers that the grading of wines should be made in accordance with the relative value of well-known types. For red wines 90.9 % have been classed as blended wines, 6.8 % as wines for storage, 2.2 % table wines and nil as bottled wines. For white wines, 9.1 % as bottled wines, 45.4 % table wines, 12.1 % storage wines, 33.3 % blended wines.

P. C.

114. The Aldehyde Phase of Alcoholic Fermentation.

PARIS, G. La fase aldeidica nella fermentazione alcoolica. *Stazioni sperimentali agrarie italiane*, Vol. 55, Pts. 10, 11 and 12, pp. 389-406. Modena, 1922.

A correlation between the amount of aldehydes present in wine and the degree of sulphuration to which the must has been subjected during the manufacturing process, was observed for the first time by PASSERINI (1906). It has since been confirmed and more clearly demonstrated by a series of experiments carried out under the direction of the author by Dr. E. GIACANELLI. These researches are complementary to the work of C. NEUBERG and his school concerning the aldehyde phase of alcoholic fermentation (published in the *Biochemische Zeitschrift*). From the practical standpoint, they are of great technical importance on account of the effect of aldehydes upon wine. An exhaustive bibliography on the subject has been furnished by E. REINFURTH (*Biochemische Zeitschrift*, Vol. 89, pp. 365, 1918).

The author has discovered by working with sugar solutions and low grade brewer's yeast that the yeast produces acetaldehyde and carbon dioxide both when it acts upon sugar and upon pyruvic acid.

This proves aldehyde to be an intermediate fermentation product and shows the formation to be the result of carboxylation. Therefore it must be derived from pyruvic acid which is formed during fermentation before the aldehyde.

F. D.

115. Grape Juice Industry.

BOURDIL, G. Le vin sans alcool. *Revue de Viticulture*, Year 29, Vol. LVII, No. 1477, pp 245-251. Paris, 1922.

VERCIER, I L'industrie des jus de raisins. *Le Progrès agricole et viticole*, Year 39 Vol. LXXVII, No. 21, pp. 490-494, figs. 1. Montpellier, 1922.

DUFoux, A. L'industrie du jus de raisin aux Etats-Unis. *Revue de Viticulture*, Year 29, Vol. LVII, No. 1478, pp. 261-266. Paris, 1921.

The authors are all agreed that for various reasons the increase in production of fermented wines will cause complications in vine growing.

To prevent such an occurrence they propose the preparation of non-alcoholic wine or grape juice. Theoretically the process is simple. After passing through the wine press or pasteurisor, the wine is left alone or drawn off and placed in a well sterilised stoppered bottle, and then pasteurised afresh. In this way a healthy drink is obtained with the nutritive value of fresh grapes, especially as regards vitamine content. Considerable quantities have been prepared at Challand à Units, Saint Georges (Côte d'Dr) in France. A frothy drink has also been made. California ranks first in the production of grape juice (in 1921 the figures reached 500 000 litres).
P. C.

116 Loss in the Grain of Maize in Storage as Silage.

GAINES, W L. (Dairy Department, University of Illinois, Urbana, Ill.) *Journal of Dairy Science*, Vol. V, No 5, pp 507-509. Baltimore, 1922.

The grain constitutes two thirds of the nutritive value of the crop and practically its entire commercial value. It is therefore of practical interest to note that maize harvested as silage is associated with the better use of the stalk for feeding purposes.

The loss of dry matter in the grain, harvested and stored in crib and silo during these experiments, which covered a period of 8 months, is estimated at 2.25 and 5.08 % respectively.
F. D.

117 Bread-Making according to the Method suggested by E. Monti.

DROUGOUL, G Sul processo di panificazione secondo il metodo proposto da E. Monti *Le Stazioni sperimentali agrarie italiane*, Vol. LV., Parts 7-8-9, pp. 303-317 Modena, 1922

Removing the bran from flour to be used in bread-making has the effect of also eliminating the aleuron grains and the vitamins ; on the other hand, the more of the integument of the wheat that is present in bread, the less digestible does the bread become, so that brown bread, although containing a higher percentage of nitrogenous substances, supplies to the body a smaller amount of protein than the same quantity by weight of white bread.

Prof. MONTI suggests a way of combining the advantages and removing the defects of white bread and brown bread.

When grinding 70-80 % of the fine white flour is taken away : 15-20 % of the reground fine bran ; 5-10 % of the coarse bran. The fine white flour makes the crumb and the re-ground bran is used separately for the crust.

The re-ground fine bran. ("farinetta") is then acted upon by enzymes, or acids, use being preferable made of grape-juice, or the serum of acid milk containing 1-2 % acidity. These substances can be replaced by fruit-juice that is beginning to ferment, if it is rendered acid by lactic, tartaric acetic, hydrochloric, or a mineral acid that becomes completely decomposed and volatilised during the baking of the bread.

If these are not obtainable, water acidulated with tartaric, or hydrochloric acid can be used, in which case, the odour is less accentuated but equally good bread is obtained.

Method of Bread-Making : 1) *For stratification* (only for rolls weighing 40 to 60 gm.). The fine white flour is worked up into dough, and the yeast added (artificial or natural yeast) in the ordinary way, the dough is made into shapes 8-15 cm. long, and these are put into so-called "acid ferments solution" and then rolled in the fine white flour which adheres to the damp surface without becoming mixed with the rest of the dough. If necessary, the operation is repeated until 15-20 % in weight of the fine white flour adheres to the surface. Then the rolls are placed in the oven, or hot chamber, situated above, or on one side of the oven and left there for about an hour. Subsequently, they are baked at a moderate temperature until the external surface of the bread assumes a golden colour and emits the characteristic smell of disintegrated aleurone grains.

2) *For re-mixing*. — The dough is made of fine white flour with the addition of about 2 % of acid milk serum, the yeast is added and the dough left to rise. Just when the dough is about to be divided into loaves, about 10 % of re-ground fine bran is added. The latter has been made to ferment separately by means of acid milk, grape juice, or milk serum containing 15 % of tartaric acid, the whole being again mixed with a kneader. The dough is then divided into loaves which like the rolls, are moistened in the solution and rolled in the fine white flour until the covering is about 10 % of their weight.

The author has studied experimentally, at the Turin Chemico-Agricultural Station, the physical and chemical changes induced in the fine bran during the making and baking of bread according to this system, and has reached the following conclusions:

The combined action of the enzymes and acids produce permanent changes in the lignocellulose of the bran which are revealed by microchemical reactions. Chemical research shows that in bran that has been acted upon by acids and enzymes, the lignified substance has split up with the formation of free cellulose and hemicellulose, so that the indigestible matters wholly, or partly, disappear giving place to simpler carbohydrates that are more easily attacked by the digestive juices of the stomach. "In consequence of these phenomena, the MONTI system is a rational process of bread-making by which most digestible bread of good flavour can be obtained from flour bolted up to 90 %".

F. D.

118. The Oil of the Mexican Poppy (*Argemone mexicana*).

I. *Bull. of the Imperial Institute*, Vol. XX, No. 3, p. 292-294. London, 1922.

II. BRAMBILA, M. Estudio físico-químico del aceite de chicalote. *La Revista agrícola*, Vol VII, No. 5, pp. 236-238. San Jacinto, D. F., Mexico, 1922.

III. Aceite de chicalote (*Argemone mexicana*). *Boletín de Agricultura, Industria y Comercio de Guatemala*, Vol. I, No. 10, pp. 424-428. Guatemala, 1922.

I — The Mexican poppy (*Argemone mexicana*) has been introduced from Mexico to almost all tropical and sub-tropical countries. Seeds collected in South Africa were sent recently for analysis to the Imperial Institute, London, to test their value as a source of oil for technical purposes. A yield of 39.5 % of oil was obtained from the moisture free seed. The extracted oil was examined with the following results: specific gravity at 15/15° C, 0.9220; refractive index, 40° C, 1.466; solidifying point of fatty acids, 22.8° C; acid value 21.6; saponification value 192.7; iodine value 123.7 %; unsaponifiable matter 1.14 %; volatile acids, soluble nil; insoluble 1.16. The meal left after extraction of the oil from the seeds was analysed as follows: moisture 10.2 %; crude proteins 24.6 %; ash 7.7 %.

Drying tests indicate that the oil does not dry readily but that it might be employed in admixture with linseed oil as a cheap substitute for the latter for the preparation of paint etc. It is used as a lubricant and illuminant in Mexico and the West Indies, and is said to possess a medicinal value. It seems probable however that the only important commercial use for the oil would be in the soap-making industry.

The meal should not be used as a cattle food owing to its alkaloid content and purgative action. The material could however be utilised as a manure, which would be of value on account of the large proportion of nitrogenous constituents.

II. — The wide-spread distribution of *A. mexicana* is confirmed and also the value of the oil, which although not equal to linseed, may be used as a substitute.

The author obtained 26.7 % of oil by the cold pressure method, and 35.88 % by petrol extraction. In the first case the colour resembled linseed oil but lacked the characteristic odour; in the second case the oil was darker and was purified by the addition of 1 % concentrated sulphuric acid. Easily saponified with soda, forming a soap of good quality.

Analysis of the oil of Argemone mexicana.

Specific gravity at 15° C 0.9224 (pressure) to	0.9280 (solvents)
" temperature	258° C
" temperature	326° C
Solidifying point below	15° C
Ash	0.52 %
Iodine value	130.98
Free fatty acids (as oleic acid)	0.4 %
Fatty acids (insoluble)	94.11 %
Solidifying point of fatty acids (mixture of fatty acids) . .	26.07 %
Fatty acids (liquid)	73.93 %
Oleic acid (liquid acid)	7.30 %
Solidifying point of fatty acids	11° C
Iodine value of mixture of fatty acids	141.04

III. — At the request of the "Dirección de Agricultura" of Guatemala, the Director of the Chemical Laboratory of the Faculty of Natural Science, at the University of Guatemala has made extractions of and examined the "Chicalote" oil. Yield up to 36 %; useful for soap making and for painting, for which the clear colour is preferable to that of linseed.

The plant may be cultivated during the dry season (sown in September, harvested in December and January) or as a catch crop with maize. Trials are being made under the direction of the "Dirección de Agricultura".

F. D.

119. The Use of Sulphur Fumes in Copra Drying.

WELLS, A. H., and PERKINS, G. A. (Bureau of Science, Manila), in *The Philippine Journal of Science*, vol. XXI, No. 1, pp. 49-53, plates 2. Manila, July 1922.

The demand for high-grade oil and the difficulties connected with drying copra on small plantations has occupied the attention of the Bureau of Science, Manila (Philippines). Modern machinery can be economically employed only on very large plantations, and the present paper records certain modifications in the process of sulphuring copra which have given successful results from the commercial standpoint in the Philippines and which might be readily adaptable elsewhere.

The sulphuring apparatus is described in detail (including cost of outlay), the preparation of the nuts; the actual drying process and the quality of the product obtained. Sulphured coconut meal can apparently be dried without sunshine, if necessary. In cases where there is a very heavy rainy season the copra has been dried within 2 or 3 weeks in well ventilated sheds; the plates show the various methods of spreading and stacking inside and out. The latter requires 4 days or more, depending on the weather.

Although the sulphuric acid formed does not actually remain in the oil, it is found in the press-cake, and consequently the author advises light sulphuring. It has been found that when about 1 kg. sulphur per 3 000 nuts is used, this serves as a protection against mould, and no difficulties are found in expressing the oil or in using the cake for animal feed. The cake is in fact superior to the ordinary grade of cake made from rancid, mouldy copra.

Sulphuring not only has a lasting effect as regards resistance to mould, but the attack of copra beetles is also checked, and the process is consequently of distinct value to the copra trader who often is obliged to re-dry low grade copra and to combat these attacks.

If a rapidly acting hot-air dryer is used, sulphuring is rendered unnecessary but it can be employed effectively to supplement hot-air drying in home-made kilns.

M. L. Y.

120. Investigations into the Cause of Waste of Exported Citrus Fruits in South Africa and the best Methods of Storing, Packing and Transport.

THOMSON, M R H (Government Mycologist, Pretoria), PUTTERILL, V. A. (Government Mycologist, Capetown) and HOBSON, G (Division of Botany and Plant Pathology) in *Union of South Africa Department of Agriculture, Bulletin* No 1, pp 1-69, plates 14, diagr 9 Pretoria, 1922

An investigation into the cause of waste in exported citrus fruits has been in progress in South Africa, and the results of experiments made by the authors during 1921 (a continuation of work undertaken in 1919-20) are here reported.

Experiment I. — To determine the effect of low temperature on the fruit, and to ascertain the best storage temperature.

Result. — Low temperatures were proved to be harmful: even up to 40° F brown discoloration was noticeable; above 40° F no harmful effects were evident, and it has been found that a temperature range limited to 43-48° F is suitable, and fruit stored within these limits should arrive in fresh condition.

Experiment II. — To determine the effect of comparatively high temperatures on stored fruits.

Results. — In two well-ventilated greenhouses with high temperatures the amount of wasted fruit was negligible, but the amount of wilting was serious. This confirms the suitability of a medium temperature (43-48° F).

Experiment III. — (a) To test the value of ventilated holds compared with cold store during transport; b) to compare the carrying quality of fruit at the beginning and end of the season; c) to test the "holding up" quality of fruits from cold store and ventilated hold after arrival on the overseas market.

Results. — In general, the export consignments showed that fruit from cold store had much less waste on arrival than fruit from ventilated holds and boat decks, and was also much fresher in appearance, although the latter fruit arrived sufficiently fresh to meet trade requirements. Cold storage developed mould more readily than ventilated holds. It is interesting to observe that cases from ventilated holds and boat decks generally realised from 2, to 3, per case less than those from the cool chamber. Attention is drawn to further points noted during the experiments.

1) Seedling oranges mould far more rapidly if wounded when fresh than when the skin is old. End of season seedlings deteriorate very quickly if bruised and inoculated with mould spores. The Valentine Late and Du Roi varieties appeared to deteriorate less rapidly than seedlings.

2) When fruit was picked unripe, a superficial spotting appeared on the skins of seedlings. These green to reddish-brown spots did not increase during storage and were apparently due to the action of liberated oil on the skin, not affecting the keeping quality of the fruit.

3) The appearance of sunken-brown spots on the seedlings was observed towards the end of the season. These enlarged during storage

PLATE VIII



FIG. 1. Orange from U. S. store showing brown discoloration owing to chilling at low temperature.



FIG. 2. Orange showing spotting due to escape of oil from skin when fruit was green.

and very much marred the appearance of the fruit. A species of *Colletotrichum*, possibly *C. gloeosporioides* was isolated from these spots.

4) A few navels were found to be black inside, due to the fungus *Alternaria citri*. The high coloration of the fruit is generally the only indication of infection. Several complaints amongst buyers overseas with regard to this defect have been received, and the spraying of navels is consequently advocated.

Emphasis is laid on the fact that high temperature is not in itself a cause of waste (apart from wilting) but allows deterioration amongst fruit which has been *carelessly handled*. In this respect certain warnings are given, and the following points noted for avoidance:

1) Piling in large heaps and leaving exposed for several days fruit intended for export.

2) Pulling fruit from the tree ;

3) Cutting fruit with long stems ;

4) Using splintery lug boxes and export cases ;

5) Native pickers with clippers of all kinds, no gloves and with no efficient supervision ;

6) Faulty sizers carelessly worked ;

7) Throwing boxes containing fruit on to springless vehicles ;

8) Faulty packing and inefficient supervision in the packing house ;

9) Rough handling of loaded cases and stacking bottom upwards, bulge side up and trampling on them.

If attention is given to factors having a bearing on elimination of mechanical injury, wastage due to mould would be almost entirely reduced.

Much depends on the quality of the wrappers used. A special wax tissue wrapper prepared in Miss THOMSON'S laboratory at Pretoria has given excellent results. This paper prevents wilting, and also keeps apart from other fruits liable to become " wet rotted ". These wrappers should be invaluable in shipments by the new ventilated hold. The previous poor quality tissue wrappers, careless grading for size etc. are responsible for much of the waste hitherto noted in exported fruit.

Fruit of Export quality. — Several types of citrus fruits are unsuitable for export, especially as regards the navel-orange. Investigations show that the brittle skin coarse fruits, end-of-season fruits, hail-marked or stung fruits should be kept back. The quality of the commercial fruits has been too much neglected. The small fruits such as the Valentine Late, Du Roi, Mediterranean Sweet, Joppa, Jaffa and Pine-apple varieties might profitably be given more attention.

POLE EVANS (Chief Division of Botany and Plant Pathology) in the preface draws attention to the fact that in connection with the regulation of air circulation and ventilation during transport, the author (G. HOBSON), has examined the construction of the Elder and Fyffe fruit boats : on these boats the storing and handling of fruit has been thoroughly and systematically studied for many years, and with distinct success. The whole system of ventilation and circulation of air is one of cool air (50° F for bananas and 45° F for oranges). The refrigeration is kept in constant circulation by powerful fans which draw the air along passages on one side

of the boat and forced over brine cells and into corresponding passages on the opposite side. This cool air escapes through slides in the passages and is drawn by fans through fruit stacked in such a manner as to effectively cause even distribution of air. If necessary, fresh air is let in by means of vents, with due regard given to the undesirability of letting warm air into spaces containing cooler air and the consequent risk of sudden drops in temperature of air already in such spaces.

The appendix includes data as to trial consignments, mycological tests and freezing point determinations. The average freezing point for seedlings (ripe) was 30° F., navel (ripe), 30.2° F.; seedlings (just ripe) 29.7° F., Valentine Late (unripe) 30.1° F.

Graphs illustrate the mail boat deck temperatures, and the daily maximum and minimum temperatures, and the figures show the discoloration, spotting etc. (see Figs. I and II), methods of cutting fruits from the tree, and storage chambers and samples of badly selected fruit.

M. L. Y.

121. By-Products from Citrus Fruit.

CHACE, E. M. *U. S. Department of Agriculture, Department Circular* 232, pp 13. Washington, 1922

The Bureau of Chemistry, Department of Agriculture, United States, has investigated methods for utilising bruised, undersized oranges, grape fruit, and lemons, great numbers of which are allowed to go to waste each year. Methods are described for the preparation of excellent juice, jam, marmalade and jelly from such fruit

USES FOR THE JUICE. — Grapefruit juice, bottled: fruit washed and cut up, juice pressed, strained, and pasteurised at 75 to 85° C, bittles placed in cold storage for 60 to 90 days, juice clarified, sweetened, blended with loganberry juice, bottled and stored.

ORANGES: Vinegar: Juice pressed and strained, brewer's yeast added, after fermentation ceases, strained again; vinegar formed; bottled, sterilized, clarified.

LEMONS. — Preparation of citrate of lime and citric acid.

CANDIED CITRUS PEEL. — Preparation described.

FRUITS AS A WHOLE: — Marmalades, and jellies. — Methods of preparation applicable also to home use.

F. D.

122. Preparation of Preserved Olives in Algeria.

LAMBERT, P. Préparation des conserves d'olives en Algérie (Rapport présenté au Congrès international d'oléiculture de Marrakech). *Revue agricole de l'Afrique du Nord*, Year 20, No 178, pp 824-832, figs 4. Algiers, 1922.

The author draws attention to the increasing importance of preserved olives on the market.

Three-fourths of the yield for the last two years has been used for this purpose and the remainder for oil. The chief olive growing district in Algeria is at St. Denis-du-Siq. The majority of the plants sent to Morocco come from this district.

The author summarises the work done in this connection in other countries : Greece, Spain, Italy, Turkey, Portugal and California (1).

In Algeria, brine is used for the green olive, and the brown or semi-ripe olive, and brine or salt for the black olive. A description is given of the different methods employed. For black olives, the Greek method is adopted which consists in placing the olives in layers of salt (10 kg. per 100 kg. olives), hermetically sealed in casks turned once every 3 to 4 days, and than every fortnight. The preserved olives are ready for sale at the end of two months.

A list of the varieties of olives for propagation in Algeria and Morocco is given ; olive trees which are grown for the production of olives for preserving, require a light and well-drained soil. The list includes :

La Sigoise (St. Denis-du-Sig).

Olive de Tlemcen.

La belle Chemlal de l'Oued-Amizour.

La grosse de Miliana.

The olives utilised for their oil are usually confined to trees on dry soil on the mountain slopes : viz :—

La Sigoise (20 to 22 litres of oil per quintal).

L'olive de Tlemcen.

La Chemlal de Sfax.

With reference to the clearing of certain plantations in Morocco which owing to insufficient attention, have given unsatisfactory results with Algerian stock, the author suggests the appointment of Moroccan planters who would be held responsible for the purchases and the distribution of the stock on its arrival in Morocco.

P. C.

123 The Characteristics of Lavender Perfume.

ANONYMOUS Les caractéristiques de l'essence de lavande et la foire de Digne, in *Office Régional agricole du Midi, Bulletin trimestriel*, No 4, pp. 37-45 Marseilles, 1922

Up to the present the actual definition of lavender perfume has been too restricted both in France and elsewhere. This fact combined with the marketing of the fraudulent scent known under the name of "Travail" perfume has been a source of much confusion. As a result of the fair at Digne, held on February 12, 1921 and others on October 1, 1921 and October 7, 1922 in the same town, the Office Régional du Midi has undertaken the complete analysis of all the samples shown. This analysis will include the following determinations :— density at 20° C, rotatory power at 20° C, solubility in 70° alcohol at 20° C, acidity index, saponification index, ether index, ether content % (expressed as linalyl acetate). These results are tabulated and include 127 groups, classified according to the districts in which they were produced.

P. C.

(1) See R 1922, No. 1058. (Ed)

124. Different Methods of Curing Tobacco in South Africa.

OOSTHUIZEN, J. du P. (Manager Experiment Station, Rustenberg) in *Journal of the Department of Agriculture, Union of South Africa*, vol. V, No. 2, p. 131-150, figs 12, bibliography. Pretoria, 1922.

The rapid increase in the world's consumption of cigarettes has led to a corresponding increase in tobacco leaf production in South Africa (in 1921 approximately 18 000 000 lb weight of leaf) a large proportion, however, consisting of inferior or low grade leaf tobacco due to lack of regular methods in growing, curing and handling the crop. The light type of tobacco offers the best market to the grower, but even under favourable conditions of soil and climate, the present methods of curing, render the crop unfit for cigarette manufacture.

With a view to assisting growers to remedy this defect and also to improve the quality of their tobacco generally, the author has explained in detail the various changes that take place in the leaf in the curing process, and the results obtained with the different methods. The control of the two chief factors heat and moisture is responsible for the resulting quality of the leaf. A full description is given of the four methods of curing viz. air; flue (1), sun, and fire-curing. As regards flue cured tobacco a one week's record is given of the exact temperature maintained, moisture regulations, etc.

The importance of careful handling after curing up to the time of sale is accentuated. Details are given as to the correct method of conditioning, grading, stacking, baling and transport. M. L. Y.

125. Factors Determining the Efficiency of Extraction and Purity of Indigo. Trials made with Time Control Test at Pusa, India (2).

DAVIS, W. A., in *Agricultural Research Institute, Pusa Indigo Publication*, No. 11, pp 1-81, tables XII, figs 6 Calcutta, 1922

Report of steeping trials made at Pusa under standardised conditions by sterilising the water, inoculating with a mass culture of a high yielding type of indican-splitting organism, and arresting the fermentation at the optimum, indicated by the time control test.

Heavy and light loading trials proved that the purity of the indigo obtained is directly proportional to the quality of the plant, but is more dependent on the latter with light than with heavy loading. The purity is, however, determined largely by the nature of fermentation. A heavy rate of loading and a high quality plant has given much more satisfactory results than lighter loading with practically the same quality of plant. Evidently the best practical results can only be obtained by combining favourable fermentation (high yielding organisms and elimination of destructive forms) with suitable conditions of loading determined by the quality of the plant.

(1) See R. 1922, No. 201, (Ed.)

(2) See R Jan 1922, No. 101 (Ed)

The advantage of liming the steeping vats is emphasised as a means of elimination of harmful bacteria.

The variation in concentration strength of the extract at different depths of the vat is noticeable, being nearly double at the base compared with that near the surface. The whole character of the liquid (acidity, behaviour towards oxidation), also varies similarly at different depths.

The time control test was found most useful before the rains when efficiency and purity are low, and a considerably higher quality indigo has been obtained by its use than that manufactured elsewhere.

Plants cut before the rains although variable in quality are much richer than those cut during the rains, and in such cases it is advisable to load lightly (75 to 80 maunds per 1000 cub. ft.). To obtain the best results as regards both efficiency and purity, it is necessary to devise a simple means of ascertaining the quality of the plant each day, and to load accordingly.

Full details are given of the factory trials carried out at Belsand and Dalsing Sarai demonstrating the comparative indigotin value of different plants and the subsequent yield of press cake.

In the appendix the author describes the method of analysis of vat liquors for indoxyl by the new *Istatinbaryta* method. It is noteworthy that although this system estimates only free indoxyl and leaves indican untouched, the results are invariably higher than by the acid method which also estimates small quantities of unhydrolysed indican. M. L. Y.

126. Composition and Utility of Sugar Cane Wax and Berry Wax (*Myrica* spp.).

RINDI, M (Professor of Chemistry, Grey University College, S Africa), in *South African Journal of Industries*, Vol V, No 11, pp 513-518 Pretoria, November 1922

I. — SUGAR CANE WAX. — On account of the hardness and high melting point of the white powdery substance on the surface of the stalk, investigations have been made to ascertain the commercial value of this wax. The author reports the recent analyses made, and the comparative values of wax extracted from fresh press cake and old cake. The latter evidently furnishes the harder, cruder wax, richer in unsaponifiable matter. The pure material is however, apparently much more suitable for industrial purposes. The unsaponifiable matter contains about 7.5 % resin acids and an adequate proportion of palmitic and stearic acids in the mixture of saturated fatty acids.

Extraction with organic solvents is considered to be the only method likely to be of commercial value. Experiments in Natal have shown that carbon tetrachloride is a suitable solvent. As much as 14-17 % has been obtained by this means.

A summary is made of the methods adopted for refining and bleaching. A special deodorising and hardening process (treatment with superheated steam at a temperature of 100-120° C for 2-6 hours) is emphasised. The hard substance thus obtained serves as a substitute for both carnauba and beeswax. The use of potassium chlorate and sulphuric acid (temper-

ature maintained at 70-100° C) has proved an effective means of bleaching, apart from the recognised use of carbonaceous clarifying agents.

II. BERRY WAX — This material is obtainable from different species of *Myrica* (*M. cordifolia*, *M. laciniata*, *M. quercifolia*, and *M. serrata*).

The dry drupes are calculated to contain 7-11 % of wax (dry weight). A similar wax is obtained from *M. caracasiana*, *M. caroliensis*, *M. cerifera*, and *M. jalapensis*.

A description is given of the method of extraction, composition, constants and properties according to the various analyses made. The value of the wax for candle making etc., is discussed. M. L. Y.

Dairying

127 Methods of Measuring the Volume of Cream on Milk.

HARDING, H. A. (Department of Dairy Husbandry, University of Illinois, Urbana) KELLY, F. W. and CHRISLER, E. S. (Gridley Dairy Company Milwaukee, Wisconsin) *Journal of Dairy Science*, Vol. V, No. 5, pp. 468-478, bibliography Baltimore, 1922

In the city trade the appearance and volume of the cream on the milk as delivered to the consumer is a matter of considerable commercial importance. This has been recognised by the milk industry and different methods of measuring the cream have been adopted. There is however an almost complete lack of literature on this subject. The authors have made a study of the various methods, and finding that they were not satisfactory for the study of the influence of plant operations on the volume of cream, there has been developed a simple and accurate method of measurement which has been found readily applicable under working conditions.

This method consists in filling round bottomed test tubes 1 inch in diameter, to a depth of 204 mm with the milk to be tested. The tubes are cooled immediately in ice water and then kept in a temperature of 40° F for approximately 20 hours. The depth of the cream layer is measured in millimetres and each millimetre of cream represents 0.5 % of cream by volume. The volume of cream as determined in this way, agrees closely with the volume of cream in milk bottles under similar temperature conditions.

This method has been extensively tested in milk plants and its advantage lies in the fact that by its use a large number of samples may be collected during a single day, the samples stored compactly, and measurements of the cream made quickly, accurately and quantitatively. F. D.

128 Preliminary Investigations on the Acid Content of Milk, on the Composition of Butter and on the Oily Taste of Butter.

HAGLUND, E. and WALLER, R. Förberande undersökningar över gräddens surhetsgrad smörrets sammansättning och uppkomsten av smörfelet "oljigt".

Kunge Landbruks-Akademiens Handlingar och Tidskrift, Year LXI, pp. 425-456, 1922.

Towards the end of 1919, the Swedish Bureau of Butter Control reported to the Central Institute for Agricultural Research (Dairy Section) that the butter during the war was of inferior quality and suggested that a special study should be made as to the cause of oiliness, a defect which reduces to a marked degree the value of the butter.

Previous researches have shown that the oiliness was only noticeable in conjunction with sodium chloride and lactic acid. As regards the latter, experiments have demonstrated that this defect occurs only when the acidity of the cream is below 1.3 %. The butter content in non-fatty materials and the methods employed in butter making are both important factors in this respect.

The preliminary tests made during 1920-1921, with a view to the modification of butter making methods, by artificial fermentation to prevent this unpleasant oiliness has led to the following conclusions :

- 1) That in the dairies, the cream should only be churned when the acidity amounts to about 35° Soxhlet-Henkel in the non-fatty portions ;
- 2) That the churning continue until a very low acidity is reached, giving a butter with the characteristic flavour of artificial fermentation ;
- 3) That a lowering of acid content of cream improves to a large extent the keeping qualities of butter ;
- 4) That the oily flavour of artificially fermented butter may be reduced if the acidity of the cream is also limited.

The experiments also indicate :—

- 1) That by increasing the degree of acidity of the cream, the non-fatty content of the butter is also lessened and the acidity of the brine is increased ;
- 2) That by adding equal quantities of lactic acid to the non-fatty portions of creams varying in fat content, the influence on the composition of the butter is nil ,
- 3) That the careful washing of the butter decreases the non-fatty content and the acidity of the brine.
- 4) That, if after the butter is washed, it is left in water for 24 hours, the acidity of the brine is still further decreased.

120 The Copper Content of Cow's Milk.

SUPPLEE, G. G. and BELLIS, B (Research Laboratory of the Dry Milk Company, New York City). *Journal of Dairy Science*, Vol V, No 5, pp. 455-467, bibliography Baltimore, 1922.

Many records are available which prove the presence of copper in animal and vegetable substances (1) but the references to the copper in cow's milk are rare. The author proposes therefore to furnish data showing the variation in copper content of cow's milk, freshly drawn, and after being in

(1) See R 1921, No. 475 (Ed)

contact with metallic copper, — a likely occurrence in milk establishments. The data is the result of 2 years work in connection with research on desiccated milk products.

Copper was found to be a normal constituent of freshly drawn cow's milk. The amounts found in milk of individual animals varied from 0.3 to 0.8 mgm. per litre. The average amount found in 23 of such samples was 0.52 mgm. per litre. Apparently neither feeding on pasture nor in the stall has any effect on the copper content of milk.

The amount of copper in milk may be considerably increased by storing and heating in a copper utensil. Slight increases in the copper content may also result from the passage of milk through copper pipes from which the tin has been worn off. Copper from this source, however, is less than that from the formation of copper compounds round brass or bronze fittings as a consequence of inadequate sanitary arrangements.

The significance of minute amounts of copper in plant and animal tissues is so far unknown. Its presence in milk particularly when taken up as extraneous contamination, may prove to be significant in connection with the high susceptibility of the antiscorbutic vitamine to oxidation. In fact, the destruction of this vitamine by acceleration of oxidation as a result of pasteurising milk in a copper vessel has already been reported.

F. D.

130 **Actinomyces in Milk with Special Reference to the Production of Undesirable Odours and Flavors (1).**

FELLERS, C. R. *Journal of Dairy Science*, Vol. V, No. 5, pp. 485-497, Baltimore, 1922

Actinomyces are often present in commercial milk samples. In normal samples these organisms constitute about 2.5 % of the total. In abnormal samples, particularly those drawn from cows in dusty stables, this figure may reach 50 %.

The principal sources of contamination are hay, straw, grain and soil and dust from these materials.

Under certain conditions actinomyces may cause an obnoxious, bitter mouldy taste in milk after a few hours of storage.

The two most active species identified were *A. griseus* and *A. albus*. These organisms grow readily in milk and are able to produce marked changes in the casein and whey. The extremely diffusible and volatile substance which causes the odour and taste so characteristic of actinomyces is not known.

Actinomyces may cause stale, musty and mouldy odours in such foods as walnuts, dried fish, cereal grains, and possibly dried eggs. They occur in conjunction with moulds in various foodstuffs, especially those in dried condition.

In studying actinomyces or in attempting to isolate them, the

(1) See R. 1922, No. 639 (Ld)

ordinary methods and media with incubation at 37° C, are unsatisfactory; synthetic media should be used together with a long period of incubation at a low temperature.

F. D.

131. Improvements in Milk Transport.

E. POHER. Améliorations à réaliser dans le transport du lait par voie ferrée. *La Revue générale du froid et des industries frigorifiques*. Year 3, Vol. III, No. 9, p. 322. Paris, 1922.

The milk supply of Paris is collected at a dépôt where it is pasteurised. In the United States, on the other hand, the milk is simply cooled on the farm after being drawn from the cow and is then put on rail.

In the author's opinion, the exclusive use of the refrigerator for milk is the ideal method of keeping it, but for the present, it is necessary to seek the immediate solution of the problem in a combination of the two above-mentioned methods.

Work on the farm: the farmer should try to cool down his milk to the lowest possible temperature after it has been taken from the cow. This could be done by standing the pails in well-water, spring-water etc.

It would perhaps be better to keep all the milk together in common dépôts, established in each village. The producers should take all their milk directly after milking to these dépôts, where it could be put into the refrigerator.

Road transport. The following objections are made to the collection and transport of milk by motor: 1) the cost would be double that of transport in carts drawn by horses, viz. from 0.05 to 0.12 fr. the litre and the extra cost would be justified only in the case of distances of 30 and over and for loads of 150 to 200 milk-cans; 2) the labour expenses involved would be higher; 3) the motor-lorry could not pass along certain roads which are only accessible to horses.

The use of the motor-lorry would however, save much time in collecting the milk; this would be a great advantage, especially in the evening.

Further, the concentration of the milk in refrigerating dépôts would remove the difficulty of narrow roads.

A branch dépôt could be established on the road passable for the lorries, which might bring the ice required for refrigeration. The present dépôts could be transformed into ice-factories.

Railway transport. In order to develop milk traffic, pasteurisation will have to be replaced by refrigeration. The latter process is most useful to dépôts cleared between 5 and 7 p. m., and is indispensable to those cleared before 5 p. m. A refrigerating car is not necessary if the milk is thoroughly refrigerated before starting and the walls of the milk-van are well insulated. The author states that at some dépôts ice is successfully used for cooling the milk-cans in vans without a refrigerating plant. He estimates that in France, the expense of hiring the vans and of purchasing, or making, the ice would amount to 0.056 fr. per litre of milk. If, however, the losses due to the slightest acidification of milk, and the low price of this commodity at a distance from the centres of consumption

are considered, it will be seen that the extra expense for ice and transport is to a certain extent counter-balanced by the profit realised on the cheaper rate of purchase and the avoidance of waste. Further, drawing supplies from a wider area would make it more possibilities to replenish the milk supply during any crisis.

F. S.

132. Wool Production.

I — HOLDFLEISS, P. Stellung und Aufgabe der heimischen Schafzucht unter den gegenwärtigen Wirtschafts verhältnissen. *Deutsche Landwirtschaftliche Presse*, Year XLIX, Nos. 31-32, pp 215-216: No 33, pp 227-228 Berlin, 1922

II — ROSE, P D The Value of Fineness and Length in wool *Journal of the Department of Agriculture*, Vol V, No 5, pp 464-466. Pretoria, 1922

I. PRESENT CONDITIONS OF STOCK RAISING IN GERMANY. — The German textile industry uses the home wool supply to intermix with the foreign inferior quality wool. Hence the reason why attention is given as much to fineness as to length. It seems therefore only fair that the producer should be paid not only in accordance with weight, but also in consideration of these two qualities. The author suggests that an agreement be fixed between stock raisers and merchants

The rearing of merinos in Germany has indicated the possibilities of the production of a long and also a comparatively strong wool, i. e. a combing wool, possessing a fineness which hitherto was only been associated with short wools used for cloth. The latter is graded as 3 A fineness, and length 2 to 4 cm. The German merinos on the other hand are now graded as 2 A fineness and 11 cm length. The quality shows a constant improvement; the wool coming from the southern hemisphere (Argentina, Australia and to a lesser extent, South Africa) has decreased as a result of the cross-breeding of fine wool breeds with English mutton breeds; especially the Lincoln breed with the fine wool. It seems that in the London and Buenos Aires markets the mixed wools, and the imported pure merinos are continually decreasing. The latter is utilised by the spinners (wool for stockings etc.), and the mixed wool for tweeds etc.

In Germany, the production of mutton has not the same importance as in England or France, owing to the high output of pork. By crossing merinos with English breeds, especially with Dishley, Leicester and Lincoln, and to a certain extent with Cotswald and Kent, a good grazing quality is produced which matures rapidly, is more vigorous and has a meat of good flavour.

The production of pure wool demands that the above advantages be put aside, and that special attention be given to feeding and housing of the sheep if good quality wool is to be obtained. It is necessary therefore that the increased cost of production should be compensated for by a high market price for the wool. The merinos should always be kept with dry feet, but the Landschaf (common type), and the English breeds are not affected by damp. For this reason the merinos are suitable for the parts of Germany where the rainfall is less than 600 mm. (Baltic coastal

area). The Landschaf is more suited to the southern and western area, and the English breeds to the North Sea littoral. The half-breed of Wurtemberg appears to adapt itself readily to an intermediate climate.

II. VALUE OF FINENESS AND LENGTH IN WOOL. — The author accentuates the importance from the industrial standpoint of the fineness and length of the wool, and considers that stock breeders should make every effort to conserve these two qualities and not to sacrifice fineness in order to obtain longer wool.

The Bradford market demands the Super quality 64's to 76's and a length of 9 to 10 cm.

F. D.

BIBLIOGRAPHICAL NOTES.

133. SCHMID, A and LANDI, J. (Central Administration of Federal Agricultural Test and Analytical Stations, Liebefeld) Die Kontrolle des Handelsverkehrs mit Landwirtschaftlichen Hilfsstoffen. *Landwirtschaftliches Jahrbuch der Schweiz*, Year 36, Pt III, pp. 405-447. Berne, 1922.

A survey is given made of the attempts made in Switzerland during the last 50 years to control the trade in farm requirements in and between the various Cantons. This is followed by a detailed description of the regulations in force during the war, and the attempts at control. Attention is drawn to the necessity for legislation, throughout the Confederation, and the inspection of the trade in agricultural material. The authors criticise the present state of affairs in connection with the trade and discuss the problems of importation and production. The delivery of goods not up to sample and the adulteration which occurs is pointed out, and it is suggested that all this is due to the lack of protective regulations with reference to agriculture and to bona fide trade and industry.

Thirdly, the authors give their opinions as to the elaboration of a federal law dealing with the inspection of the trade in agricultural material.

The following points are outstanding: scope of the law; enforcement of the enactment; arrangements as to guarantee and liability; control of private patents; the carrying out of the inspection and of the penal measures.

In the appendix, a summary is given of the various laws in force elsewhere concerning similar questions.

134. DAHLBERG, A C (New York Agricultural Experiment Station, Geneva, New York) The causes of Leaky Butter, *Journal of Dairy Science*, Vol. V, No 5, pp 421-437. Baltimore, 1922.

Butter is made leaky by large churrings, cold wash water, working butter in water, insufficient working after salting, high salt content and cold refrigerator. Well working after salting is strongly advised.

F. D.

135. CUNNINGHAM, A., and WILLIAMSON, W. T. H. (Edinburgh and East of Scotland College of Agriculture). *The Scottish Journal of Agriculture*, Vol. V, No 4, pp 420-423. Edinburgh, 1922

The author gives a brief survey of the latest methods employed for the preservation of milk. At present the so-called "Holder" process is the most popular. The milk is maintained at a temperature of 63° C for half an hour. In connection with sterilisation, a process has been devised by NIELSON in which the milk is kept at a temperature of 130-135° C under pressure in order to prevent boiling, and is then rapidly cooled.

Satisfactory results have been obtained with these two processes. The question of the effect on the vitamine content of milk treated by the Holder process and on the proteins, enzymes and vitamins of milk treated by the Nielson process would, in the author's opinion, well repay investigation.

F. S.

136. BRUCE MACULLUM, A. The Pasteurisation Process and its Effect on the Vitamine Content of Milk. *The Agricultural Gazette of Canada*, Vol. XI, pp. 524-527, bibliography. Ottawa, 1922.

The author, after consideration of data collected from various sources, has come to the following conclusions:

Pasteurisation of milk has no effect on vitamine B nor on vitamine A. In the case of vitamine A, pasteurization in a closed container is essential. The loss of vitamine C may be as much as 70%. The loss of antiscorbutic vitamine is less marked after 48 hours than immediately subsequent to heating.

F. S.

137. MACY H. (Division of Dairy Husbandry, University of Minnesota, St. Paul, Minnesota). The Care of Morning Milk before Pasteurisation. *Journal of Dairy Science*, Vol. V, No. 5, pp. 502-506. Baltimore, 1922.

If milk is obtained from clean cows (normally with a low initial count), and milked into clean *dry* utensils, and delivered to the pasteurising plant within 5 or 6 hours after milking, without cooling, the bacterial content should not be excessive for pasteurisation. Where these conditions are not possible, the milk must be cooled directly after milking.

F. D.

138. FASCETTI, G. L'indice acetico nella ricerca delle frodi dei burri. *Giornale di Chimica industriale ed applicata*. Milan, 1922.

F. D.

(1) See R. 1922, No. 639. (Ed.)

PLANT DISEASES

Diseases, parasitic, non-parasitic or of unknown origin.

139. Premature Withering of Potato Plants, observed in the Department of the Loire (France).

PERRET, C. La dessiccation prématurée des pieds de pommes de terre. *Comptes rendus des séances de l'Académie d'Agriculture de France*, vol. VIII, No. 32, pp. 848-851. Paris, 1922.

In both the mountain and plain districts of the Department of the Loire, the potato plants in some of the fields have been attacked by a premature withering of the haulms, this affection, which was already noticed in 1921, became more pronounced in 1922, caused serious injury to the crop.

In order to facilitate the description of the symptoms, the author gives to this disease (which differs in several respects from the maladies usually infecting the potato), the provisional name of "wilt disease" ("maladie du flétrissement").

In fields where this disease is prevalent, green areas composed of normal plants and brownish areas formed of plants with completely withered leaves can be distinguished at the end of August. Here and there, individuals in course of wilting can also be detected, for the foliage at the base and summit alike is much recurved. Plants that have died from wilt have a totally different appearance from those which have withered as a result of normal ripening.

In the first case, the haulm remains erect and its colour scarcely changes, while in the second, the stem usually bends over and assumes a whitish hue. On plants with prematurely withered leaves and green haulm, aerial tubers eight to ten in number are usually to be seen distributed from the base to the top.

At the time of lifting the crop, it is found that the yield of withered individuals is lower than that of normal plants, the tubers are smaller and more numerous, they are often soft, while the vascular ring is frequently yellow.

A superficial examination of the withered plants, which can be pulled up without effort, shows the wilting to be due to an affection of the roots. The curvature of the haulms is a reaction for the purpose of decreasing evaporation, while the aerial tubers prove that the natural migration of the starch has been prevented.

The wilting shows itself after the flowering period. In many cases, the plants withered within a few days, in August, during the prevalence of hot winds in a period of drought. Later, the development of the affection was much slower.

In the Department of Loire, the disease is especially wide-spread on hills between 400 and 500 in height and on dry, permeable soils of porphyritic or granitic origin. It is also common on gravelly soils with

a southern exposure, and on soils formerly occupied by vineyards, but is little known on the tertiary and quaternary formations of the Forez plain.

The malady never occurs above the height of 650 m. In infected fields, plants situated under the shade of trees, or walls, generally remain immune.

The author is of opinion that the disease has its origin in conditions due to the topographical position of the crop, rather than in the seed potatoes. The development of the disease appears to be checked by planting varieties with a strong root system ("Institut de Beauvais", "Violette du Forez"), especially if these varieties have been introduced during the course of the year.

In serious cases (90 % of the plants attacked in August) the annual yield is reduced by one half. In ordinary cases, the loss only amounts to one third, but the tubers are difficult to boil and keep badly.

In order to prevent the transmission of the disease by means of the seed potatoes, many growers have recourse to selection. They reserve the late crop for seed, and set apart for immediate consumption all the tubers from wilted plants

G T.

Plant parasites.

140. Experimental Tests with "Uspulun" and "Supersolfo" in the Control of Smut on Wheat.

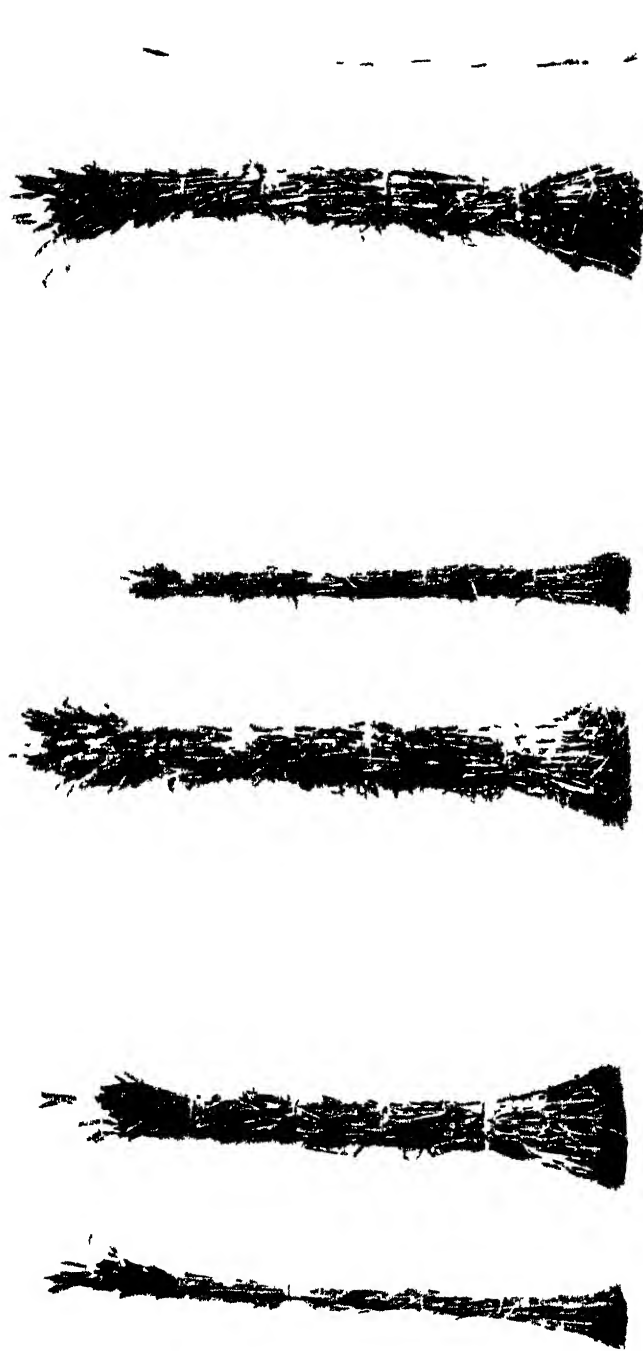
Information provided by Professor Dr JACOB ERIKSON transmitted by Baron C. N. D. DE BILDT, Delegate of Sweden at the International Institute of Agriculture

In the autumn of 1921 comparative tests of treatment for seeds were carried out by means of two fungicides: "Uspulun" (1) and "Supersolfo" (2), for the control of the disease known as smut on wheat, (*Tilletia Caries*). These experiments were made in the South of Sweden (Hylkie Gard, Limhamn) on two field plots of 1 sq. metre each; another plot, identical with these was sown with untreated seed and served as a control. The three plots were situated next to each other (the one with untreated seed being in the middle) at intervals of 50 cm. The soil was composed of good garden earth, which in all probability had never been used for growing cereals.

Winter wheat ("Panzer") harvested in 1921, was used for the seed-plots. To submit the two fungicides to the most severe tests, the author began by thoroughly infecting the seed chosen for sowing, about 200 gm. A rather large number, certainly several hundreds, of infected seeds was collected from amongst the wheat of that year. These seeds were ground

(1) See R 107, No 100 (Ed.)

(2) See R 110, No 178; also from the colonial point of view, G TRINCHEIRI, Per un preparato anticongomico e insetticida meritevole di maggiore considerazione (Firenze), Istituto Coloniale Italiano 1921 (Ed.)



A Upright growth
 B Upright growth
 C Upright growth
 D Upright growth

and the infected powder thus obtained was mixed with the quantity of seed already measured out, in a good-sized glass receptacle, the lid of which was then covered with thick paper. The contents of the receptacle were well shaken for a quarter of an hour, until the seeds were well covered with the spores of the smut fungus, especially the bristle on the apex of the seed.

The seed thus treated was divided into three equal parts of 50 grammes each, and reserved for the three ground-plots.

"Uspulun" is a greyish powder, made and sold by the "Farbenfabriken vorm. Fried. Bayer & Co." of Leverkusen near Cologne. It is principally composed of Chlorophenate of Mercury, to which is added a colouring substance to facilitate the distinction between the treated and untreated seeds.

"Supersolfo" is a dense liquid, heavy and of dark colour, prepared at the gas works of St. Paolo at Rome, from the waste material resulting from the process of purification of coal-gas. The method followed is that of Professor Bruttini, of the International Institute of Agriculture. It is principally composed of polysulphides of calcium. Since 1920 it has been experimented with in various parts of Italy, not only against plant pests, but also in the case of ectoparasitical insects on animals. The results were very satisfactory.

The treatment with "Uspulun" was done in the following way: 2.5 gm. were dissolved in one litre of water and shaken till entirely dissolved; the 50 gm. of infected seeds were then immersed in this solution, and the mixture was shaken from time to time for an hour; subsequently the liquid was poured off and the seeds were spread out to dry on a clean surface.

For the treatment with "Supersolfo", 10 cc. of this product were mixed with 1 litre of water and well shaken. At first the solution was slightly milky and emitted a strong smell of sulphuretted hydrogen, but soon the mixture became a dirty grey in colour. In this solution 50 gm of infected seeds were placed and left for an hour and stirred from time to time; the liquid was then drawn off and the seeds spread out to dry.

A third sample of 50 gm. of infected wheat seeds was sown without any treatment.

The three field plots were sown on Sept. 12; the one which received the untreated seeds was sown last in order to avoid the infection of the plots reserved for the treated seeds; if the plot used for purposes of comparison had been sown first, a new infection derived from the treated seeds might have been caused during the process of manipulation. When the sowing was finished, the plots were covered with wire netting to prevent sparrows etc. from doing damage. The wire netting was placed at such a height as to allow the plants to grow until summer without reaching it.

About a week after sowing, the plants sprouted in all three plots. During the whole of the autumn it was noticed that the plots sown with treated seeds had a more vigorous plant growth than the one sown with untreated

ed seeds. All plots stood the winter well. On June, 1922 the plants which had been treated reached the height of 65-78 cm. and were very vigorous. The plants of the plot which had received the untreated seeds, were a little lower, from 60-65 cm., and were less vigorous. On June 20 the heads of the wheat appeared but were more numerous in the plot treated with "Supersolfo" On June 22 they had formed on all the plants, but were more numerous on the plot treated with "Supersolfo" where the plants were higher and more vigorous, and almost all the heads bloomed. The plot treated with "Uspulun" seemed weaker, the heads were less numerous and smaller. The untreated plot was the weakest, the plants were lowest, the heads were smallest and very few bloomed.

The same difference could be seen on the three plots during the whole summer.

Each plot was harvested separately on August 19; the plants were then entirely uprooted. In each sheaf thus formed the stems carrying heads were counted and separated, then the healthy plants were separated from the diseased; for each group the stems were counted, tied together and weighed.

The number and the height of the stems of the various sheafs thus obtained are illustrated by the following photographs taken immediately after the harvest.

Subsequently the seeds of the healthy stems were harvested and weighed. Their number and weight is indicated in the following table:

Results of tests.

(August 1921 — August 1922).

I. Untreated Seeds:

65 healthy plants (16.2 %) weighed	300 gm	and their seeds	50 gm.
335 diseased " (83.8 %) "	1350 "		
<hr/>			
400	1 650 gm.		

II. Seeds treated with "Supersolfo":

381 healthy plants (77.4 %) weighed	1 950 gm.	and their seeds	500 gm.
111 diseased " (22.6 %) "	300 "		
<hr/>			
492	2 250 gm.		

III. Seeds treated with "Uspulun":

407 healthy plants (99.5 %) weighed	1 900 gm.	and their seeds	350 gm.
2 diseased " (0.5 %) "	0.4		
<hr/>			
409	1 900 gm.		

This table shows that the proportion of diseased plants in the ground-plots sown with untreated seeds was 83.8 %, and was reduced to 22.6 % in the plot where the seeds had been treated with "Supersolfo", and

to 0.5 % in the plots where the seeds had been treated with "Uspulun". Consequently "Uspulun" was the most effective fungicide and its efficiency is practically complete.

The "Supersolfo" was also proved to be a first class fungicide—according to the conditions of the experiment (concentration and duration of immersion) — although there remained an infection of 22.6 %.

But the superiority of "Supersolfo" over "Uspulun" must be noted with regard to the quantity and quality of the harvest. This superiority was to a certain extent evident in the number of healthy seeds: 381 healthy stems of the plot treated with "Supersolfo" weighed 1950 gm and yielded 500 gm of grain, whereas 407 healthy stems from the plot treated with "Uspulun" weighed only 1900 gm and yielded only 350 gm of grain.

It must be admitted that the increased production obtained on the two plots which received the treated seeds is due to the fact that these seeds had been freed from the spore of cryptogams attached to them. For this reason they were better able to produce healthy stems and full heads than the infected seeds.

Nevertheless the above mentioned explanation is not sufficient to account fully for the phenomenon. If this hypothesis were correct, the increase of yield should have reached its maximum in the plot treated with "Uspulun", where the proportion of infection was reduced to the minimum (0.5 %). But actually, the increase of yield was notably greater in the plot sown with seed treated with "Supersolfo", in which the proportion of infection was reduced only to 22.6 %.

It can therefore be supposed that "Supersolfo" has a direct fertilizing action, and in fact there is no doubt that it has given better results than "Uspulun".

Further research now remains to be made with "Supersolfo" to ascertain if a greater concentration of the liquid or a longer duration of immersion can cause a greater reduction of the infected proportion, or if it is not possible to obtain the maximum effect both as regards the fungicidal action and as regards the increase of yield by using a combination of "Supersolfo" and "Uspulun".

141. *Vermicularia varians*, a Deuteromycete Injurious to the Potato, in France.

FOEX ET. La dartrose de la pomme de terre. *Comptes rendus des séances de l'Académie d'Agriculture de France*, vol. VIII, No. 32, pp. 844-848, Paris, 1922.

Towards the middle, or the end, of the summer of 1922, a disease responsible in some cases for severe injury and similar to the so-called "dartrose" due to *Vermicularia varians* Duc (1) made its appearance on the potato in various parts of France (Charente and Charente-Inferieure,

(1) See B. 1915, No. 328. (Ed)

Vendée, Vienne, Loire, Ain, Bas-Rhône, Seine, Seine-et-Oise, Loiret, Saône-et-Loire, Rhône, and Lot-et-Garonne).

In Alsace, the disease is localised on the variegated marls and muschelkalk, and does not exist on the alluvium (Loess).

In Ain, it has been found on deep, damp siliceous marl of excellent quality.

In Forez, the disease has been observed on fairly dry granitic, gneissic and porphyritic soils. The crops on tertiary, or quarternary, soils were less attacked. The disease has frequently shown itself on hill slopes (Alsace, Loire) with a southern exposure (Loire) and at the altitude of 350 m (Ain) or between 350 and 650 m. (Loire).

Drought is supposed to be a factor predisposing the plants to this disease, but in the opinion of the author, there are undoubtedly other unknown causes affecting its diffusion and severity.

In Alsace the disease was first reported as occurring on a variety of potato imported from Holland, but later it appeared on all the other kinds. In the Department of Ain, it has attacked Richter's, Imperator, Wohltmann, and Fin de siècle, in Saône-et-Loire the disease has been seen on Merveille d'Amérique and Wohltmann. In the Department of the Loire, the seed-tubers of native and Breton varieties have been equally affected. Serious outbreaks have occurred on Lesguin (Vendée) and Saucisse (Vienne). In a field of Lot-et-Garonne in which were cultivated Czarine, Institut de Beauvais, Industrie, Violette du Forez and Geante Bleue, only the two first varieties were attacked. Late crops suffer less than early ones; this holds good even for the same variety. It has sometimes happened that the same variety, when grown in two different places, has been attacked in the one case and has remained immune in the other.

While awaiting the results of further investigations which may increase our knowledge of the disease, it is well not to use for "seed" any tubers which come from fields, or even localities where the disease has been prevalent. An attempt ought to be made to disinfect the tubers. The burning of the aerial portions of the potato-plant can be carried out afterwards.

G. T.

142. **American Gooseberry Mildew (*Sphaerotheca Mors-uvae*), in Emilia, Italy (1).**

MANARESI, A. La *Sphaerotheca mors-uvae* (Schw.) Berk., nell'Emilia. *Rivista di Patologia vegetale*, Year XII, No. 7-8, pp. 83-84. Pavia, 1822.

In July, 1922, in Massa Lombarda (prov. Ravenna), *Sphaerotheca mors-uvae* was found on gooseberry and currant bushes, which had apparently been distributed in the neighbourhood for some two years, possibly first introduced on seedling's brought from other localities.

(1) See R. Dec. 1922, No. 1121. (Ed.)

According to reports, in Massa Lombarda this Erysiphe has not caused much damage, probably due to the fact that constant pruning off of diseased branches etc. has been practised, and frequent spraying throughout the year with polysulphide or Bordeaux mixture 4-5 %.

G. T.

143. *Oidium* sp. on *Cineraria* in Italy.

NANGERONI, G. L. Un oidio delle Cinerarie. *Rivista di Patologia vegetale*. Year XII, Nos. 7-8, pp. 85-86. Pavia, 1922.

During August 1922, in the Botanic Gardens at Pavia, an undetermined *Oidium* sp. was observed for the first time on the leaves of several *Cineraria* plants, grown under glass during the early stages of development and kept well-watered.

The means of control adopted have been to collect and burn the infected leaves and by spraying the rest with sulphur.

G. T.

144. *Trametes hispida*, a Polyporaceae injurious to the Anacardiaceae *Schinus dependens*, in France.

MORQUER, R. Sui un nouvel hôte du *Trametes hispida* Bagl., *Bulletin trimestriel de la Société mycologique de France*, Vol. XXXVIII, Pt. 3, pp. 170-172. Paris, 1922.

At the beginning of February 1922, in the Botanical Gardens at Toulouse a specimen of *Schinus dependens* Orteg was seen to be attacked by *Trametes hispida* Bagl., a Polyporaceae hitherto not reported as a parasite of this Anacardiaceae.

Cultures have been made of the said Polyporaceae.

G. T.

145. *Fomes Inzengae*, Parasitic on Poplar in France.

BIERS, P. M. Le *Polyporus* (*Ungulina*) *Inzengae* De Not parasite du Peuplier. *Bulletin de la Société de Pathologie végétale de France*, Vol. IX, Pt. 3, pp. 166-168. Paris, 1922.

For several years, a poplar (*Populus nigra*), growing on the borders of the Avenue Beauséjour in the Parc St. Maur (Seine) was seen to be in a state of decay. The leaves fell off, and finally the tree was left standing bare. Numerous fructifications were found, identified by the author as belonging to *Polyporus Inzengae* De Not. but which he considers would be more appropriately classified as *P. (Ungulina) Inzengae* De Not. as this fungus possesses all the characteristics associated with the genus *Ungulina*, as described by PATOUILLARD (1900) (1).

The Polyporaceae in question has been found both on the poplar and on the oak. In the present case, the parasitic nature of this fungus was evident and the deleterious effect on the trunk which was broken down by the wind in November 1921, owing doubtless to the fact that a gradual rotting had set in.

(1) P. A. SACCARDO (*Flora italica crypto ama Hymeniales* Rocca S. Casciano, 1916, P. No. 15, p. 998) considers *P. Inzenae*, De Not synonymous with *Fomes Inzengae* De Not. Cooke. (*Ed.*)

All the poplars in the valley were well lopped between 1910 and 1912, as was done in the preceding periods and it appears that a certain number of poplars had already died off, showing various abnormal growths.

In the case of this particular tree, the Polyporacea had in all probability acted as a wound parasite. The fructifications appeared after two or three years and increased in number, and the tree gradually died off. The fructifications, though scarce on the trunk, were abundant in the upper sections and this corresponded with the affected parts.

At the end of 1921, a specimen of this Polyporacea was collected from a poplar near Melun, probably about 50 years old, which 20 years previously had had its top broken off by a storm. In May 1922, a mass of fructifications of the fungus was observed on this tree but did not appear to have had any deleterious effect.

This fact leads to the conclusion that the Polyporacea is undoubtedly parasite and is probably a typical wound parasite. In some cases, the attacks of parasite fungi are short and severe, but it does not seem to indicate, to judge from the examples quoted, that this particular Polyporacea is rapid in causing injurious effects to the poplar. The attack appears to be insidious and shows no symptoms on the external surface even when the tree is most certainly infested.

At the end of September 1922, three other poplars were observed in the same valley in Parc St. Maur, fairly wide apart, but in every case parasitised to a similar extent by the fungi, and in a state of complete decay. These trees as in the first case were well pruned between 1910 and 1912 and the tops were cut back. These observations confirm the opinion that a close correlation exists between the faulty lopping of these trees and the inroads of the parasite.

G. T.

146 Ascoporous Form of Oak Oldium observed in Siena, Italy (1)

NANNIZZI, A. Sulla forma ascofora dell'*Oldium quercinum* Thicm. *Rivista di Patologia vegetale*, Year XII, Nos. 7-8, pp. 87-90. Pavia, 1922.

Towards the end of September, 1922, in Siena, numerous perithecia belonging to a *Microsphaera* sp. were observed on *Quercus pedunculata* Ehrh. species, in some cases isolated, in others forming part of an oak wood, the oidium attacking the upper surface of the fully developed leaves, and also the newly-formed leaves. The author has described this species under the name of *Micr. quercina* (Schw.) Burr.

G. T.

147 The Withering of the Needles of the Stone Pine in Campania, and other Pathological Phenomena observed on the same Conifera.

TROTTER, A. Intorno al seccume degli aghi ed agli altri fenomeni patologici del Pino domestico (*Pinus Pinea* L.). *Rivista di Patologia vegetale*, Year XII, Nos. 7-8, pp. 91-106, figs. 4. Pavia, 1922.

In Campania, and especially in the vicinity of Avellino, the needles of many of the smaller branches, particularly the terminal, of *Pinus*

(1) See R. Dec. 1922, No. 1121, (Ed.)

Pinea have not infrequently been observed in certain years to be of a light-green colour in late spring. Later, they gradually turn yellow and then become brown, ultimately assuming the colour of a dead leaf.

An examination of the branches and of the affected leaves revealed the following more or less noticeable and wide-spread pathological symptoms:

a) a yellowing, or apical withering, extending from the tip towards the base of the needles;

b) slight constrictions of the tissues of the needles accompanied by discoloured brownish patches, as if the surface had been pressed, or bruised;

c) drops of resin which usually exuded at the base of the needles and inside the sheath;

d) a yellowing and total withering of the needles and the premature withering of the sheath;

e) the formation of blackish dots on the surface of the leaves, on the sheath, and occasionally on the contiguous epidermis of the branch.

These black dots have been identified as the fructifications of *Pestalozzia Hartigi* v. Tub. of *Pini Pineae* and of *Cladosporium Laricis* Sacc. of *Pini Pineae* Sacc. and Trott.

The first of these micromycetes occurs exclusively on the needles, and generally on their upper half; the second is found, not only on the needles, but also on a large part of the sheath, and further infests the portion of the twig adjacent to the sheath.

As a rule, phytopathological works contain few if any data regarding the Stone Pine, for which reason, the author considers it desirable to give in systematic form, based on the results of exhaustive bibliographical investigations, all that is at present known of the pathology of this tree, such as injuries to the buds and shoots, trunk, branches, wood, roots, leaves, fruits and seeds.

G. T.

Animal parasites.

146 Biological Notes on different Insects found in the Department of the Isère (France).

FALCOZ, L. Notes biologiques sur divers insectes des environs de Vienne en Dauphiné *Bulletin de la Société entomologique de France*, No. 15, p. 223-228. Paris, 1922.

Biological observations made on representatives of the Orthoptera, Hymenoptera, Coleoptera and Diptera in the Department of the Isère and especially in the neighbourhood of Vienne.

The following facts are specially worthy of mention.

In the springs of 1921 and 1922, *Calliptamus italicus* L. appeared in very large numbers in the district of St. Symphorien-d'Ozôn, where

it caused considerable injury to the crops. Already in 1916, this Orthopteron had increased to an abnormal extent in the neighbourhood of Lyons, and during the summer, swarms of the winged form penetrated into Lyons and invaded the streets of the city.

Hoplocampa brevis Klug caused considerable injury to pear trees in the neighbourhood of Vienne during the spring of 1922. In some orchards, especially when the trees were grown as espaliers, or were planted near the wall, about 25-30 % of the young fruits were attacked. The infested fruit continued to turn black, and fell about May 29, soon after the exit of the larvae. Therefore fruit that harbours the hymenopteron should be gathered and destroyed before that date.

The elms near Vienne have been attacked for some years by *Galerucella luteola* Müll. The injuries caused have increased from year to year owing to the steadily growing number of the Coleopteron. None of the known parasites of this insect have been found in the many thousands of *G. luteola* that have been bred artificially during the last three years. Some predatory insects are, however, fairly numerous on the spot, but their efficacy is limited.

During 1922, the damp produced by the frequent rain in June and July induced the outbreak of a disease in the larvae of *Galerucella* that were about to pupate. This disease, which was probably of bacterial origin, destroyed a large number of the insects. G. T.

149. Coleoptera in Bengasi.

ZANON, V Contributo alla conoscenza della fauna entomologica di Bengasi *Memorie della Società entomologica italiana*, Vol I, pp 112-139 Florence, 1922.

From the economic standpoint, the following species are selected :

- 1) *Cicindela melancholica* F — abundant in kitchen-gardens
- 2) *Calosoma maderae* F.; found both in the garden and on the steppes, the larvae destroy a large number of harmful insects which attack vegetables; the adults on the other hand, injure the bees.
- 3) *Dromius crucifer* Luc. found on an olive tree feeding on the *Aspidiotus hederae* Vallot.
- 4) *Tenebrioides mauritanicus*, L. in the military grain stores.
- 5) *Carpophilus bempterus* N on figs. laid out to dry
- 6) *Cybocephalus rufifrons* Reitt., on trees attacked by *A. hederae*.
- 7) *Laemophloeus minutus* Oliv. in the barley stores.
- 8) *L. ferrugineus* Steph. ditto.
- 9) *L. ater* Oliv ditto.
- 10) *L. ater* var. *capensis* Wattl. ditto.
- 11) *Silvanus surinamensis* L.
- 12) *Chilocorus bipustulatus* L. on olives covered with *A. hederae*
- 13) *Exochomas* sp. ditto.
- 14) *Pharus varius* Kirsch, on prickly pear covered with *A. hederae*.
- 15) *Pullus subvillosus* var. *pubescens* Panz., on olives covered with

A. hederæ.

16) *P. pallidivestis* Muls. ditto.

17) *P. pallidivestis* Muls. var. *nanus* Muls. on figs laid out to dry.

18) *Rhizopertha dominica* F. in the granary.

19) *Zonabris tenebrosa* Cast, injurious to petals of several vegetables and flowers. In March 1915, a serious damage was reported, the olive flowers being gnawed away.

2) *Cassida vittata*, Vill. on leaves of mangolds; not however frequent.

21) *Spermophagus subfasciatus* Boh; it is uncertain if this coleopteron a native of Brazil, was introduced accidentally into Italy (1); it is found in large quantities in Bengasi, where the climate is favourable for its propagation. Leguminous crops are not extensively cultivated in this area and the food products, imported from Italy, are soon exhausted. It is possible that this insect may have come from Sicily.

22) *Laria rufimana* Boh., on dried beans from Sicily; the Hymenopteron braconid (*Sigalphus thoracicus* Curtis) has been found feeding on the larvae.

23) *L. ornata* Boh on chick peas imported from Italy.

24) *Cyphocleonus morbillosus* F. found gnawing the leaves of cultivated *Zizyphus vulgaris*.

25) *Lixus anguinus* L. has seriously damaged the cauliflowers, common cabbage and kale. In 1916, a severe attack was reported in the "terra rossa" area. Two generations each year have been observed. Each plant acts as a host for a single larva.

26) *L. iunci* Boh. serious damage to mangolds. This species also breeds twice a year

27) *Calandra granaria* L. in the wheat and barley stores.

28) *C. oryzae* L. ditto.

29) *Eccoptogaster rugulosus* Ratz. causes serious damage to apricots and almonds. A successful means of control has been employed recently by painting during winter all the branches and trunks with lime and sulphate of iron dissolved in sulphuric acid. In March 1916, several chalcids (*Cerocephala eccoptogastri* Masi) feeding on the larvae of *E. rugulosus* were collected from the dead twigs of apricot trees.

30) *Tropinota (Epicometis) squalida* Scop. injurious especially to beans as they gnaw the pistils of the flowers; also attacks roses, cloves and several other flowering plants. Occasionally has been observed to collect on the cabbage flowers left for seeding purposes, causing subsequent destruction. A search for the insects should be made either in the early morning, or in the middle of the day. G. T.

150. The Natural Enemies of Certain Caterpillars.

BERNARD, C. De vijanden van verschillende rupsen, in *De Thee, Korte santeekeningen van het Algemeen Proefstation voor Thee*, Year III, No. 3, pp. 87-90, plates 1. Batavia, 1922.

Several tea planters in Java have recently followed the advice of the Tea Experiment Station in order to destroy the caterpillars which cause

(1) See R. 1921, No. 580. (Ed.)

devastation on the plantations. Until now the method adopted has been to collect the moths, pupae and larvae and whenever possible the eggs, as there appeared to be no other effective means of control. The Experiment Station recommends that the larvae and the pupae should not be destroyed at once but should be kept for a certain time in a muslin enclosure. After a few days the parasites within the pupae and larvae produce small flies and wasps and these if set free over the plantations would destroy the caterpillars.

For example *Setora nitens* is often parasited by a Tachinid; and *Andraca* or "bunch caterpillar" by a fly slightly larger than the *Setora* parasite.

This method of breeding parasites and setting them free over the plantations has proved very successful. D. V. S.

151. **The Propagation in Italy of the Hymenopteron *Aspidiotiphagus lounsburyi*, an Endophagous Parasite of the Coccid *Chrysomphalus dictyospermi* ("bianca-rossa").** (1).

PAOLI G La moltiplicazione dell'endofago della Bianca-rossa in Italia. *Il Coltivatore*, Year 68, No. 33, pp 477-480 Casale Monferrato, 1922.

The Chalcid, *Aspidiotiphagus lounsburyi* Berl and Paoli which was introduced into Italy from Madeira at the end of March 1922, and set at liberty (between April and July), to the number of four to five thousand in the gardens of Chiavari (Prov. of Genoa) where *Chrysomphalus dictyospermi* Morg ("bianca rossa") occurred in great numbers, especially on palms, orange-trees and ivy, has already spread and propagated itself actively.

On every orange leaf examined at the beginning of November, several individuals of *Chrys. dictyospermi* attacked by the endophagous parasite were discovered. On some palms, 10 % of the adult coccids might be regarded as having been killed by it. A general average infestation of 2 % may be estimated, which is a large proportion, if we take into account the great difference in the numbers of the two antagonists, and the short time that has elapsed since the introduction of the hymenopteron.

In spite of the late season, many of the latter insects were reared on leaves placed under separate bell-glasses and they proved quite as vigorous as those hatched in the spring, or the insects which hatched out on the leaves that arrived from Madeira at the beginning of November 1922.

In the opinion of the author, the activity displayed by *Aspid. lounsburyi* shows not only that this Hymenopteron found in Liguria conditions suited to its propagation during the spring, but indicates that there may be a rapid increase, by means of several successive generations, in the course of the following months. This insect is a native of a country with a very uniform climate and in order to be able to decide whether

(1) See R. 1922, No. 665. (Ed.)

it has really become acclimatised, it will be necessary to see how the parasite stands the winter.

Since the introduction of the endophagous parasite by means of material coming from Madeira presented serious difficulties, intense breeding operations under special conditions have been successfully carried out, with the object of obtaining an Italian stock to serve as a supply for further dissemination. To this end, small specimens of *Phoenix canariensis* growing in pots were infected with the coccid at Chiavari and then placed in a greenhouse, where the temperature, humidity etc. were much the same as outside. From the beginning of September to the end of October 1922, ivy-leaves were sent from Madeira and infested with individuals of *Chrys. dictyospermi* which had been parasitised by the hymenopteron; these were then placed in the greenhouse so that as soon as the parasitic insects emerged they found themselves in a confined space with a number of victims at their disposal, since the plants of *Phoenix canariensis* were heavily infested. They were therefore obliged to lay their eggs on the coccids in the greenhouse, as they could not disperse over a more extended area. After the hymenopteron had been barely two months in the greenhouse, about 90 % of the adult coccids were found to be infected, while many of the younger individuals were also parasitised.

G. T.

152. The Hymenopteron *Anthemus leucaspidis* n. sp. Parasitic on *Leucaspis pini* on *Pinus halepensis* and *P. sylvestris*, in Spain.

GARCÍA MERCET, R. Una sub-familia nueva de Himenópteros Calcidoideos. *Boletín de la Real Sociedad Española de Historia Natural*, Vol XXII, No 8, pp 363-370, figs 4. Madrid, 1922

L. O. HOWARD described in 1896, under the name of *Anthemus chionaspidis* (n. sp. and gen.), a hymenopteron identified as belonging to the Mimarinae

The author has recently found on the leaves of *Pinus halepensis* attacked by *Leucaspis pini*, a hymenopteron which appears to be identical in every respect with the above-mentioned *Anthemus chionaspidis*.

An examination of this parasite has led the author to the conclusion that the gen *Anthemus* should be transferred to the fam. Encirtidae and be classified as a new sub. fam. Antheminae, the characteristics of which are described in detail.

At present the following species have been notified :

1) *A. chionaspidis* Howard, parasite of *Chionaspis graminis* in Ceylon

2) *A. chionaspidis* Howard, var. *hilli* Dodd, parasite of *Ch. graminis* in Australia.

3) *A. emersoni* Girault, observed only in Australia.

4) *A. leucaspidis*, n. sp. — parasite of *Leucaspis pini* found on *Pinus halepensis* and *P. sylvestris*, in Spain (prov. Madrid and Segovia); a detailed description is given of the new species.

G. T.

153. *Thrips* Parasitic on Greenhouse Plants and their Control.

AHLBERG, O. *Vaxthustripsarna. Kungl. Landbruks-Akademiens Handlingar och Tidskrift*, Year 61, No. 6, pp. 520-530, figs. 19. Stockholm, 1922.

Three species of thrips, *Parthenothrips dracaenae* Neeg., *Heliethrips haemorrhoidalis* Bouche and *H. femoralis* Rent. have been found in hot-houses in Sweden; the two first are very common throughout the country, but the last is very rare, and has been found only twice.

The external morphology, life-history and development of these species is dealt with very briefly the object being to supply practical information to unprofessional gardeners.

As regards the control of these injurious insects, fumigation and spraying with insecticides were both tried. The first mode of treatment would only be effected with substances containing nicotine such as "Jofurol" and Cook's fumigant, since the regulations of the public authorities make it very difficult to use hydrocyanic acid. The two first-mentioned fumigants proved quite inadequate, as they destroyed too few of the aphides.

Good results were, however, obtained with the solutions, "nicotoxin", or nicotine sulphate, which proved especially effective. Nicotoxin is a new product, similar in composition to the soap manufactured by the "Tekniska fabriken Jofur, Lidigön, Stockholm". For spraying, from 20 to 25 gr. of nicotoxin is used for every litre, or kilogramme, of water. The nicotoxin must be mixed in cold water. The nicotine sulphate of which a 10 % solution has been on the market for a long time, must be diluted for spraying by the addition of 60 to 100 parts of water.

It should be noted that the spraying has to be repeated at short intervals as the eggs of the parasite are laid within the tissues of the plant and they cannot be reached so easily as is the case during the latter stages of the pest, so the treatment must be regulated to destroy each brood as it hatches out. Care must be taken that the solution gets into the leaf-sheaths, folds of the leaf-blades etc., which are likely to harbour the parasite. The number of applications depends upon the care with which they are carried out and on the structure of the plants.

In the case of plants that are easily treated, such as *Fatsia*, two sprayings are sufficient, whereas *Phoenix* needs several applications. In order to protect neighbouring, healthy individuals, it is necessary to begin spraying as soon as possible after the presence of the parasite has been observed.

O. A.

154. *Spilarctia multiguttata*, Lepidopteron injurious to Vanilla in CochinChina.

PHAM-TU-THIEN. Un insecte nuisible aux feuilles de vanillier en Cochinchine (*Spilarctia multiguttata* Wilkr). *Bulletin économique de l'Indochine*, New Series. Year 25, No 155, pp 438-441, tables 1. Hanoi-Haiphong, 1922.

In June 1922, two specimens of caterpillars found to have done serious damage to vanilla leaves on a plantation in Hon-gan (Thudâumêt)

were sent for examination to the Phytopathological Laboratory attached to the Scientific Institution of Indo-China.

Feeding with leaves of *Pothos scandens* L., which they eat with avidity, a male and female were eventually identified and found to be *Spilarcia multiguttata* Wilk.

A description is given of the life history of this Lepidopteron.

As a preventive measure it is advisable to spray the plant with a mixture of lead arseniate and some substance, for example dextrine, which will adhere to the leaves readily and thus ensure an equal distribution of the insecticide. This is recommended in consideration of the heavy rainfall in Indo-China.

G. T.

155. *Laspeyresia molesta*, Injurious to the Peach in France (1).

TROUVELOT, B. Sur la présence en France d'un nouvel ennemi des arbres fruitiers, *Laspeyresia molesta* Busck. *Bulletin de la Société entomologique de France*, No. 15, pp 220-223 Paris, 1922.

During the summer of 1922 in an orchard near Frejus (Varo), several peaches were found, seriously riddled with holes through insect attack and later the adults were identified as Microlepidopteron, *Laspeyresia molesta*, Bruck.

Peach trees showing similar symptoms of attack were noticed for the first time in 1919, but little attention was given to this fact, as it was considered of a passing significance. However, on the contrary, this was not the case and instead the injuries were intensified. In 1922, the attack was general and in addition to this, several shoots of newly planted peach trees were noticed to be shrivelled up.

Although only a few specimens were available in the Entomological Laboratory in Paris, a parasite of the Microlepidopteron was found which has led to the hope that in France, as in America, the indigenous parasites will adapt themselves readily to living on *L. molesta*.

A description is given of the biology of this insect collected from Japanese and American resources, as a result of recent investigations in these countries

G. T.

156 The Black Aphis of Peach-Tree Roots (*Anuraphis persicae* var. *niger*), in Veneto.

MALENOTTI, A. Una grave infestione dell'*Anuraphis Persicae* var. *niger* Smith, sulle radici del pesco. *Il Coltivatore*, Year 38, No 31, pp 409-413, fig. 1 Casale Monferrato, 1922

The insect *Anuraphis persicae* Boyer var. *niger* Smith was found in the summer of 1922 at Pescantina (Province of Verona) on the roots of peach-trees growing in a nursery of more than a thousand square metres and which contained some thousands of young peach-trees planted in the preceding March. Where this insects had congregated in large numbers, the roots of from 1 to 4 mm. in diameter showed abrasions, and

(1) See R. Jan. 1922, No. 134. (Ed.)

sometimes pyriform swellings of a diameter nearly twice as large as that of the healthy part of the root.

Subsequently, the diseased areas changed to a blackish colour.

While the *niger* variety was infesting the roots, the leaves were equally severely attacked by the typical species (*A. persicae*).

Although *A. persicae* var. *niger* has existed in Italy for over a decade, it has hitherto not been at all wide-spread, and appears to attack only the American varieties of peach. This variety of aphid possesses, in addition to the root form, an aerial form which attacks branches, buds and leaves and causes leaf-curl similar to that induced by *A. persicae*.

The roots of the young trees in the nursery were exposed in May, and then watered with a mixture of tobacco extract (4 %) grated hard soap (1.5 %) and petroleum (6 %) but, with little effect. It is probable however, that if the treatment were deferred until the middle, or end of June, when the individuals of the var *niger* would be all congregated on the roots, it would be possible to destroy all the pests. If necessary, the young trees can be watered (without uncovering the roots), with a 2-3 % solution of carbolic tobacco extract and 0.5 % soap. Half a litre of this mixture is sufficient for each plant in the nursery. G. T.

157 *Polygraphus pubescens*, a Coleopteron Injurious to the Spruce Fir in the Neighbourhood of Paris.

BOUVIER, E. L. and LESNE, P. — Un ennemi des épicéas dans la région parisienne. *Comptes rendus des séances de l'Académie d'Agriculture de France*, Vol. VIII, No. 32, pp. 826-830. Paris, 1922.

The recent death, or withering, of some spruce firs growing in the park of Maison-Lafitte near Paris gave rise to investigations that proved the trees in question to be severely infested by the Scolitid *Polygraphus pubescens*. The unsatisfactory condition of the spruces forming a small clump about half-way down the Avenue Voltaire is probably due to the same cause. Most of these trees are seriously injured, or dead. This cluster of spruces has probably formed a centre of infection whence the beetles have spread to the healthy, vigorous trees in the neighbourhood, as several spruces in the Avenue Augereau, and the greater number of those growing in the Jardin du Parc, have been destroyed by the same parasite.

Unless the spread of this Scolitid is arrested by some natural enemies, the other spruces in the park will probably be attacked owing to the thousands of beetles produced on the infected trees. In order to prevent the parasites from gaining a hold outside, as well as inside, the park, those on the dead and infected trees must be destroyed by felling and burning the spruces. It is not sufficient merely to burn the branches and bark, as is done in the forests, for this allows a certain number of the insects to escape. Any sickly trees that may be near should be cut down and burnt if badly infested, in any case they must be carefully watched by experts, for adult beetles in search of food, or shelter, prefer diseased to healthy spruces.

The hymenopteron *Sirex juvencus* and a small Longicorn successively attacked the trees in the park which previously has been attacked by *P. pubescens*, thus completing the destruction begun by the latter.

P. pubescens has probably been introduced only lately into the Paris area. Of recent years, it has been reported from the Departments of Nièvre and Eure, and always as a parasite of the spruce. A very nearly-related form *P. subopacus*, was found in large numbers in 1914 on the conifers in the vicinity of Rheims.

During 1920, R. HICKEL reported the presence of *P. pubescens* in the Department of Loiret, where however, it only damaged a few trees. He is of opinion that the wide-spread attacks of the coleopteron are but the indirect consequences of the injuries wrought by the drought of 1921 in the spruce plantations of the plain, where in many places three-quarters of the trees perished. In fact, before the War, the spruce unlike the pine, appeared totally immune from wood-eating insects. G. T.

BIBLIOGRAPHICAL NOTES.

158. HEGH, E. *Termites: General (Description - Distribution - Classification - Biology - Life history - Food - Haunts - Habits)*. Pp 756, figs. 460 + 1 plate Brussels, 1922.

This publication constitutes the first part (general) of a series of studies, to which HEGH has given his attention for several years. The damage caused by termites in Central Africa and in all tropical regions is very considerable. All organic material is eaten or destroyed and their insidious mode of attack renders them especially dangerous to railway buildings and rolling stock. It is evidently very important to make a thorough investigation as to the best means of prevention and control of these insects. Numerous methods have been tried and will form the basis for the second part of the authors work, which is in course of preparation.

The following chapters are included:

- I. Description of termites.
- II. Geographic distribution and classification.
- III. Habitat and life history.
- IV. Food. — Termites on dead timber.
- V. Structure — and classification — and propagation.
- VI. Relation between the termite colonies. Natural enemies — Parasites and hosts — Vegetation acting as a cover for termite nests — Agrogeological action — Influence of external agents.

The addendo includes the nomenclature of species, sub-species and varieties of termites in Africa at present known and described, and also a rich bibliography. G. T.

CURRENT NOTICES

Legislative and Administrative Measures.

Austrian Law (Lower Austria), concerning the Protection of Forests. (June 13, 1922) — This law prescribes that every owner of forest land shall give notice of all projected fellings, exceeding an area of 0.5 hectare in itself, or of 1 hectare including the adjoining area, which has already been felled but has not been reafforested. In cases where a single owner intends to carry out felling in several places none of which by itself exceeds 0.5 hectare, but which in all, are in excess of this area, he is bound to make a declaration as to all the areas. Thinnings which affect more than half the total number of trees on the area concerned, are for purposes of this law considered as wholesale fellings (*International Institute of Agriculture Bureau of Legislation, Textes législatifs de l'année 1922, No 10*)

Bulgarian Law concerning the improvement of crop yields and the conservation of rural property. (January 3, 1922) — This measure has for its object the general improvement and intensification and encouragement of all branches of agriculture (field crops, stock breeding, vine-growing, sericulture, bee-keeping), and of agricultural industries, also to protect rural properties and farm stock and to indemnify the owners in case of losses (*International Institute of Agriculture Bureau of Agricultural Legislation Textes législatifs de l'année 1922, No 4*)

Regulations concerning the importation and exportation of potatoes in Denmark. (Decree, September 13, 1921). — In Denmark various regulations have been imposed concerning the importation and exportation of potatoes, with special reference to wart disease (*Synchytrium endobioticum*). (*International Institute of Agriculture, Bureau of Agricultural Legislation, Textes législatifs de l'année 1922, No 10*)

French measures concerning Potatoes. — To control the Potato Colorado Beetle (*Leptinotarsa decemlineata*), several legislative and administrative measures have been adopted in France (*International Institute of Agriculture, International Review of the Science and Practice of Agriculture, and Textes législatifs de l'année 1922, No 17*)

Electrical Power in the French Country Districts. — The Ministry has approved the grant of a loan of one thousand two hundred million francs, with interest at 4 %, to the community in general, to the syndicate, and to the municipal associations, with a view to the extension of electric power in the country districts.

Sale of Chemical Fertilisers in the Dominion of Canada. (June 28, 1922). — It is forbidden to manufacture or import any fertilisers to be sold, offered or held for sale in Canada, unless each brand is registered at the Ministry and a registration number has been assigned to it. Application for registration should be made by the manufacturer or the importer in such form as the Ministry prescribes, and must be accompanied by a registration fee of ten, twenty or thirty dollars for each brand registered, according as it contains one, two, or three of the following substances, that is to say nitrogen, phosphoric acid or potash. Each application for a registration number should be accompanied by a statement giving the following particulars: *a*) name and address of manufacturer; *b*) name and address of person applying for registration; *c*) brand name and trade mark, if any; *d*) the guaranteed analysis, stating separately in minimum percentages: — water soluble nitrogen, total nitrogen, available phosphoric acid, total phosphoric acid, potash soluble in water, available nitrogen when the nitrogen is purported to be available under the provisions of the Act; *e*) the name of each material from which the fertiliser is made; *f*) in the case of basic slag or natural rock phosphate and a mixture of both, the fineness thereof. An inspector may enter any premises to examine any fertiliser or other material claimed to be of fertilising value and shall have the right to take official samples therefrom. A certificate of analysis signed by an official analyst appointed under this Act shall be *prima facie* evidence of the particulars of the analysis therein set out. (*International Institute of Agriculture, Bureau of Legislation. Textes législatifs de l'année 1922*, No. 8)

Law regulating the sale and inspection of root vegetables in the Dominion of Canada. (June 28, 1922). — Potatoes put on the market in Canada shall be graded as follows: *a*) Canada A quality; *b*) Canada B quality; *c*) Canada C quality (classified according to size). Onions shall be graded as follows: *a*) fancy quality; *b*) choice quality; *c*) standard quality; *d*) boilers. Potatoes or onions sold direct or through the agency of another person, either by bag, closed barrel, or closed crate or in bulk in car lots, must be distinctly marked with initials of Christian names and full surname and address, and in the case of a firm or corporation, the firm or corporate name and address and the grade of the potatoes or onions as prescribed by this Act, in a plain and indelible manner, before the package is taken from the place where it is packed. All potatoes, onions, artichokes, beets, carrots, parsnips and turnips offered for sale shall be sold by weight, and the standard pound avoirdupois shall be the unit of weight used. Provided that when any of the foregoing vegetables are offered for sale with the top leaves attached, commonly termed by the trade "green vegetables", or when potatoes are sold or offered for sale by the closed barrel, this section shall not apply to the same. Any inspector may enter upon any premises to make examination of any potatoes or onions suspected of being marked or packed in violation of any of the provisions of the Act, whether such potatoes or onions are on the premises of the owner or on other premises, or in the possession of a railway or steamship company. (*International Institute of Agriculture, Bureau of Agricultural Legislation. Textes législatifs de l'année 1922*, No. 9)

Law concerning the protection of forests in New Zealand (11 February 1922). — There is hereby established a Department of State to be called the State Forest Service. The State Forest shall consist of: a) Commissioner of State forest; b) Direction of Forestry; c) Secretary of Forestry. d) such conservators, rangers and other officers as may be from time to time be appointed as officers of the State Forest Service. The State Forest Service shall be divided into two branches, namely the Professional Branch and the Administrative Branch. The Minister shall in every case determine the duties to be performed. The State Forest Service shall have the exclusive control and management of: a) All matters of forest policy; b) All State forests (whether provisional or permanent); c) planting and thinning of State forests, and the making, laying out and maintaining of plantations and nurseries, and the distribution of trees therefrom; d) the granting of leases, permits, licenses and other rights and authorities, granted under this Act or any enactment hereby repeated; f) The collection and recovery of all rents, fees, royalties and revenues of the Department; g) generally, the administration of this Act. — The Governor General, may by proclamation, set apart any lands vested in the Crown. The Director shall from time to time prepare working plans for each State forest. The working plan for any State forest shall, subject to rights existing at the date of approval of the plan, as herein after provided, regulate the management of that forest for such period, not exceeding ten years, as may be stated on the plan on that behalf. A working plan shall specify: a) the maximum area from which forest produce may be taken annually; b) the maximum quantity of forest produce that may be disposed of annually; c) the silvicultural operations proposed to be carried out during the currency of the plan; d) such other matters as the Director thinks fit. Every working plan shall be subject to the approval of the Minister: The Minister may, subject to this Act, grant licenses, leases, and permits thereunder in respect of any land within a State forest.

Financial Provisions — There is hereby established in the Public Account, a separate account to be known as the State Forests Account, which shall for all purposes be deemed to be the same account as that established by the same name under the State Forests Act, 1908. The State Forests Account shall be credited with: a) All moneys standing to the credit of that account at the commencement of this Act; b) all moneys hereafter payable to the credit of that account of this or any other Act, whether now in force or hereafter passed; c) All moneys received by the Crown as rents, royalties, licence fees, charges, fines, awards for damage, the value of the articles confiscated, and all other revenues, whatsoever accruing from the management of State forests, and the operation of this Act. There may from time to time be paid out by the State Forests account, such amounts as may be appropriated by Parliament for all or any of the following purposes, namely: a) For the acquisition of private lands, pursuant to this Act, for the purposes of State forests, including incidental expenses; b) for the construction of road and tramways or other means of access to or passage through any State forest; c) for the purchase or hire of buildings, machinery, plant equipment, and appliances under this Act; d) for the establishment and maintenance of forest plantations and nurseries, and for purposes incidental thereto; e) for

the payment of grants or subsidies to any local authority or public body for planting reserves or for the establishment and maintenance of plantations ; f) For the payment of interest and other charges on moneys borrowed for the purposes of this Act (including moneys heretofore borrowed and outstanding for the purposes of the State Forests Act, 1908) ; g) for the payment of all salaries and contingent expenses incident to the State Forest Service ; h) for any other purposes in respect of which moneys are made payable out of the said account by this or any other Act, and generally for the payment of expenses incurred in the administration of this Act (*International Institute of Agriculture. Bureau of Agricultural Legislation Textes, législatifs de l'année 1922, No. 12*).

Greek regulation concerning the Control of the Olive Fly. — To facilitate the control of the olive pests in Greece, the "Cassa del olivo" has been established in accordance with regulation No. 2805 June 21/July 4, 1922, under the direction of the Ministry of Agriculture, Head Office at Athens. (*International Institute of Agriculture. La lutte contre la mouche des olives dans les divers pays. Rome, 1922 pp 87 and Textes législatifs de l'année 1922, No 18*)

Experiment Stations and Agricultural Instruction.

Arizona University and Research Station. — The Administrative board has approved the expenditure of \$17 500 for land and construction of buildings and a pumping plant for the poultry department of the College and Station Work has already started A tract of 45 acres adjoining the existing Yuma date orchard and horticultural substation, has recently been purchased A garden of 1 acre has been laid out on the adjoining land The University will be used both for experimental and instruction work The present crop of wheat is the largest ever recorded in the State and consists almost entirely of the Early Boart variety introduced about 15 years ago by the Station The College is starting a campaign urging the use of Arizona wheat for bread making (*Experiment Station Record, Vol. 47, No 3, abstract number Washington, Oct. 1922*)

California University and Station. — A department of range management has been established with Dr A W Sampson as the Head, who was, for 15 years plant ecologist of the Forest Service, United States Department of Agriculture and for 11 years in charge of the Great Basin Grazing Experiment Station at Ephraim, Utah It is planned to carry on range experiments covering the principal forage types and climatic conditions of the State, as well as studies to reduce the mortality of live stock from disease, exposure, poisonous plants and predatory animals, the utilisation of range roughage as supplementay feed in winter, and the securing of a higher percentage of offspring of herds and flocks on the range (*Experiment Station Record, Vol 47, No. 3, abst. number Washington, oct 1922*)

Kansas College and Station. — The college and station are cooperating informally with the recently organized South-western Wheat Improvement Association, which has its headquarters in Kansas City, in a lengthy campaign to improve the quality of winter wheat produced in Kansas and adjacent

States. The program agreed upon has two principal objects: 1) A change in wheat buying practices, especially at country centres, so that the prices paid to individual wheat growers will more nearly reflect quality differences than the present methods, and 2) improvement in methods of production to eliminate or minimize the factors which now affect quality. It is expected that the campaign will have the support of all agricultural and commercial interests of the south-western winter wheat region and that it will be chiefly educational (*Experiment Station Record*, Vol. 47, No. 1 Washington, 1922)

Funds for experimental work in South Carolina, U. S. — The State legislature of South Carolina has appropriated \$50 000 for experimental work, about half to be expended at the college and the remainder at the substations and for co-operative experimental work on different soil types in the State (*Science*, Vol. LVI, No. 1443, p. 224. Philadelphia, Aug. 1922)

Crop Experiment Station in the Sahara at El Arfiâne. — The organisation of this Station has been delayed owing to the war. At the present time the land is partly prepared and an Artesian well established in 1920. Investigations are chiefly devoted to date growing, the American researches having introduced a new phase of study in this respect. The best stocks are collected at El Arfiâne, sent from various quarters and a study is made of the propagation of superior varieties, especially with reference to the sucker formation or "djebars" and their disinfection. Trials are to be made as to the best methods of cultivation, such as, distance between the palms, the effect of salts, particularly sodium chloride, phosphates and green manures. Attention will be given to diseases, and also to ripening and packing of dates. Stock breeding will be considered because it is the source of manure. It is proposed to study the effect of various forage crops recently introduced.

Work in the Textile Department in connection with the improvement of English wool. — At the meeting of sheep breeders in the textile Department of Leeds University it was decided to make crosses between native ewes and Peruvian Merino rams, with a view to the improvement of the English Merino wool. Prof. BARKER considers that the importation of Peruvian animals would give a wool four times more valuable than the average British wool. If these rams were bred at an altitude of from 14 000 to 15 000 ft. above sea level, in bleak areas, it is suggested that they would do well in the bleaker parts of England and Scotland (*Live Stock Journal*, Vol. XCVI, No. 2538, p. 522. London, 1922)

The Scottish Colleges of Agriculture maintain a close connection with the districts which they serve by means of their systems of extra-mural work, including lectures and individual instruction, demonstrations and experiments, and advisory work. The Calendar for 1922-23 of the Edinburgh and East of Scotland College includes a notable development of work in connection with school gardens which have been laid down under the guidance of the College Staff at 196 schools; 7 supplementary school centres are visited by the Staff once a week for practical instruction in the school garden, combined with theoretical instruction in the laboratory. (*Nature*, Vol. 110, No. 2766, p. 621. London, November 1922)

Agricultural Education and Research in Canada. — The horticultural work of the Ontario Department of Agriculture is to be consolidated

at the Ontario Agricultural College. The consolidation will include the provincial Fruit Branch, the vegetable specialist's work, the Vineland Experimental Station, and the college horticultural department. — What is believed to be the first attempt in Canada to utilize radio telephoning by a Government Department for the distribution of information of special interest to farmers took place May 11 and 13, 1922. On these dates lectures by the Ontario Minister of Agriculture and the Secretary and supervising Director were broadcasted by the Ontario Department of Agriculture over a radius of 150 miles from Toronto. — Steps are being taken by the recently organised Canadian Horticultural Council for organising a system in Canada for the registration of new varieties of plants. — A scholarship in horticulture has been established at the University of British Columbia by the provincial Fruit Growers Association (*Experiment Station Record*, Vol. 47, No. 5, p. 499, Washington, October 1922).

Dairying at the Oka Agricultural Institute, Quebec. — Report on the Dairy branch at the Oka Agricultural Institute (Canada), value of the Ayrshire and French Canadian breeds as regards milk and butter production; importance of cow testing, description of new sanitary stables. (B ISIDORE, *The Agricultural Gazette of Canada*, Vol IX, No 6, pp 498-505, figs. 2. Ottawa, 1922)

Agricultural College, Trinidad. — A College for the study of Tropical Agriculture has been opened at St. Augustine, Trinidad, and its first session began in the autumn of 1922. (*Science*, Vol LVI, No 1413, p 228 Philadelphia, August 25, 1922)

Experiments made at the Royal Agricultural Station at Modena (Italy), 1921-1922. — Trials made with a new variety of wheat "Gentil rosso No. 15", selections made over a period of nearly 10 years, which indicate that this variety has always retained its valuable qualities viz strength, good tillering properties, large and abundant leaves, stiff straw which prevents lodging, early maturity and infrequency of attack by rust, it is a superior variety suitable for fairly rich soils in the valley

The tests with Manitoba and Hybride de la Paix have been less satisfactory; a single variety (Manitoba) amongst the four tested does not give a high yield and is not popular amongst the farmers owing to the small grain. The Hybride de la Paix, has not given encouraging results during the last two years, and does not appear suited to prevailing weather conditions on Emilia.

Further experiments have been made both in the laboratory and field, with seeds soaked in nitrates, phosphates and sulphate solutions before sowing. Neither the nitrates nor the phosphates appear to have a favourable effect, and the nitrates beyond certain limits have proved deleterious. Good results have, however, been obtained with manganese sulphate, the laboratory experiments confirm the field tests (1). It is stated that the manganese has a small fertilising effect (0.3 %) and in consequence it is supposed to act as a stimulant. This supports the theory that manganese acts as an oxydising agent, not only directly but also indirectly by transporting and fixing the oxygen in the soil (2).

(1) See *R.* 1921, No 1213

(2) See *R.* 1922, No. 538. (*Ed.*).

According to M. VILLEDIEU (1), it is the lime only and not the copper in the Bordeaux mixture which has a toxic effect on the mildew. To verify this supposition, experiments have been made at Massa Finalese with two rows of vines, using a mixture of 6 kg lime + 1 kg aluminium. After 4 sprayings, made at weekly intervals, the attacks of mildew were so serious that it was necessary to have recourse to copper sulphate. Experiments made elsewhere have also given negative results (2).

Experiments are now in progress with the fungicide Upsulun (chlorophenate of mercury) — also phytopathological observations and public analyses.

Foundation of a Phytopathological Institute in Roumania. — The Ministry of Agriculture in Roumania has approved the foundation of a Phytopathological Institute in connection with the Agriculture College at Luj.

School of Agricultural Technique in Switzerland. — The Government has decided to found in "Ecole de technique agricole" (Decree, October 25 1920), for purposes of agricultural instruction, at Champ-de-l'Air, Lausanne. The course will include, stock breeding, agricultural machinery and implements, technology, rural administration etc. At the commencement there will be a single department only — viz stock breeding, for the training of breeders and judges and also inspectors (stock and meat), and secretaries of breeding syndicates. Theory and practice will be included and will deal with the five species of domestic animals common in the Canton. The regulations admit to the school only those students who hold a Swiss Agricultural Diploma. (*La Terre Vaudoise*, Year XIV, No 41 Lausanne, October, 1922).

Congresses.

XI International Agricultural Congress May 22-26, 1923. Paris. — Committee Rooms — Hôtel de l'Académie d'agriculture de France, 18 rue de Bellechasse, Paris VII^e, fee 25 francs)

PROGRAMME

PART I. — *Agronomy.*

I Improved crop methods (cereals, potatoes, beets, leguminous forage crops) — Direction of Improvements — Formation of an International plant breeders association — Adequate measures to ensure the protection of agricultural innovations.

II. Increase in cultivated crop yields, by disinfection or by bacterial inoculation

III Distribution of agricultural implements with a view to the reduction of manual labour.

PART II. — *Agriculture and its Influence on International Relationships.*

I Harmonious effect of well developed agricultural associations

II Emigration and immigration

III Adoption of the metric system — Unification of control methods at the customs

PART III. — *Rural Economy — Agricultural Education*

(1) *Comptes rendus de l'Académie d'Agriculture de France*, Year VI, No. 31, pp. 762-768, Paris, Aug. 1920.

(2) See R. 1922, No. 112 (Ed.)

I. Waste land, causes, consequences, preventive measures; improvement of labourer's conditions, encouragement of collaboration of farm workers and owners

II Development of professional farm associations; suitable methods for adoption

III. Offices of Agricultural Book-Keeping.

IV. Supervision of the changes in land property in the different countries

V Taxation

VI. Agricultural instruction Rural education Farmers' wives' Associations

PART 4. — *Hygiene — Livestock*

I Standardisation of Methods of Milk and Butter Control

II Advantages of an International collaboration as to methods of feeding stock, and the nutritive value of the feeds

III. Standardisation of certificates of origin and of health certificates for export of livestock.

PART 5 — *Vine-Growing*

I Extension of the Madrid Convention and of the original names of vines

II Prohibition and its effect on the wine industry.

III Question of original Producers

PART 6 — *Forestry*

I Forests and the war, general situation, efforts and means for reafforestation

II. Fires: protective measures — insurance

III Chemical utilisation of timber: cellulose, charcoal, distillation, by-products

IV Diseases of trees

PART 7 — *Tropical Agriculture*

I. Home legislation with respect to the Colonies

II Means of obtaining capital for the Colonies.

III. Manual labour in tropical regions — Conservation, extension and improvement — Adaptation of farm implements to tropical crops

IV Control of diseases and pests of tropical crops

V Technical progress.

STANDING ORDERS OF CONGRESS.

ARTICLE 1. — The XI International Agricultural Congress will be held in Paris on the 22-26 May, 1923

ARTICLE 2 — The Congress shall consist of official delegates from the Government, Public institutions and associations exclusively agricultural (Societies, Syndicates, Co-operations, etc) The fee for each delegate is fixed at 25 francs (French)

ARTICLE 3. The delegates shall receive on the payment of their fee, a card from the organisation committee which is not transferable.

ARTICLE 4. — The programme of the Congress shall be entirely in the hands of the organisation Committee.

ARTICLE 5. — The Congress will include general meetings, special committees and visits to the agricultural institutions.

ARTICLE 6. — The members only shall have the right to assist at the proceedings of the meetings, take part in the visits arranged by the Committee, present propositions and take part in the discussions.

The delegates from the Public Administrations in France and elsewhere shall partake of the advantages offered to the Members of the Congress.

ARTICLE 7. — The programme shall be divided into 7 sections.

1) Agronomy (Applied science, general improvements, control of diseases and pests, improvement of crops).

2) Agriculture and its effect on International relationships

3) Rural Economy (Credit system, co-operation, agricultural education).

4) Economy in livestock.

5) Vine-Growing.

6) Forestry.

2) Tropical agriculture.

ARTICLE 8 — The programme for each branch shall be arranged by a sub-committee appointed by the organising Committee

The Sub-committees shall prepare preliminary reports on questions decided to be submitted for discussion at the Congress. These reports shall be transmitted to the organising committee within a given period in order to permit the publication as a whole or in extract form, before the Congress

ARTICLE 9 — The delegates desirous of taking part to the Congress, should send all information to the organising Committee before March 15, 1923, arrangements to be made by the sub-committee

ARTICLE 10 — All the opening Meeting, the Organising Committee will hand over its responsibilities to the International Agricultural Committee which will act as a provisional Bureau

A definite Committee will be appointed without delay. President, Vice-President and Secretaries.

ARTICLE 11. — The sections will consist at the first meeting, of the various (President, Vice presidents and Secretaries

ARTICLE 12. — The Sub-Committees shall act in concert with the Organising Committee as to the agenda of the General Meetings

ARTICLE 13 — No question will be put forward for discussion at the General Meetings before the matter has been dealt with by the Sub-Committee. The decisions must always be presented in written form.

The speakers who intend to take part at the General Meetings or other Meetings shall transmit to the Secretariat, twenty-four hours in advance, a résumé of their speech for the procès-verbaux. In cases where no résumé is forthcoming, the Secretariat report will be used.

Speeches will be limited to fifteen minutes, unless the Assembly decides otherwise

ARTICLE 14. — French shall be the official language of publications and procès-verbaux.

ARTICLE 15. — A report of the proceedings at the Congress shall be published under the direction of the organising Committee. The Committee

reserves the right of making the necessary arrangements with reference to memoranda or communications contained therein.

ARTICLE 16. — The Committee has the final decision in all matters relating to the foregoing regulations

International Conference at Madrid for the Control of the Olive Fly (*Dacus oleae*). — On the initiative of the Spanish Government and under the auspices of the International Institute of Agriculture, an international Conference will be held in Madrid on June 18-21, 1923, to consider the means of control of the olive fly (*Dacus oleae*). The Ministry of Foreign Affairs in Spain requests the collaboration of the various Governments before April 1, 1923.

At the present time the following persons are members of the organising Committee.

President: Count Vallesa of Mandor and Montornés.

Vice-Presidents: MM. Bernardo Mateo Sagasta, Director of the Agricultural College, Madrid, Ignacio Girona, President of the Catalanian Agricultural Institute of St Isidore, Barcelona.

Delegates: The Director of the Plant Disease Station of the Alphonse XII Institute of Agriculture, Madrid; M Jaime Nonell, expert attached to the Agricultural Department at Barcelona; the Director of the Ministry of Agriculture's olive-growing station at Tortosa, Count de Casa Rojas and M. Rojas y Moreno representing the Ministry of Foreign Affairs; M Alberto Castiñeyra Boloix, Inspector General of the Agricultural Service, representing the "Junta C. Agronomica", Marquis de Alonzo Martinez representing the Farmers' Association of Spain; M Leandro Navarro, Director of and representing the Plant Disease Station of the Alphonse XII Institute of Agriculture

Secretaries: MM Francisco Bilbao y Sevilla, Agricultural Expert, Spanish Delegate at the International Institute of Agriculture; Louis Rodriguez Lopez Neyra, of the Agricultural Department.

The Spanish Ministry of Foreign Affairs desires to receive notification of support by the various Governments before April 1st, 1923. At present the following notifications have been received: France: delegate, M Marchal, Director of the Entomological Station, Paris.

Italy: delegate, a member of the Italian Embassy at Madrid.

Peru: delegate, the Consul of Peru, Madrid

Greece: delegate, the Greek Ambassador, Madrid.

International Phytopathological and Entomological Conference. Wageningen (Holland), June 25-30, 1923. — Suggestions as to problems for discussion should be addressed to T. A. C. SCHROEVERS, Villapark, 8, Wageningen (Holland). The Organising Committee has arranged the following programme; Discussion on Plant Diseases from the general pathological standpoint; demonstration experiments, especially with the diseases of potatoes; discussion of the organisation of the Phytopathological Service in Holland; discussion on international laws; demonstrations of methods of disease control used in Holland; discussion on parasitic fungi and demonstrations of research work; discussion and inspection of international collection of cultures (fungi). Several excursions will be arranged, in order to demonstrate the damage caused by disease on acid and alkaline soils. Visits will be made to the nurseries at Bos-

koop and Almeer, on land situated below sea level etc etc. The official language at the conference will be English, discussions however will be permitted in French and German

International Stock Breeding Conference at the Hague (Holland), August 29-September 4, 1923. — Those wishing to take part at this Conference should address communications to M H G. A. Leignes Bakhover, Secretary of the Executive Committee, Landbouwhuis Leenwarden (Holland) A fee of 12 florins should be enclosed which will give the right to receive all publications and to participate in the excursions The Ministry of Agriculture in Holland suggests the possibility of arranging at the same time an International Show of horned cattle :— Programme (provisional) Part I Science *a*) recent theories as to the importance of heredity in relation to stock breeding ; *b*) What are the latest opinions as to feeding ? Part II. Grading *a*) What should be registered in the herdbook and what is the best method to adopt in order to ensure sufficient guarantee of accuracy ? (Methods connected with milk production excluded) , *b*) What methods should be adopted for milk control ? Are the international regulations feasible ? Part III : Official Associations and their activities , *a*) In what way can the Government and local authorities encourage cattle rearing other than through the veterinary service ? *b*) In what way can stock improvement societies make the best use of scientific data and registration ? Part IV Hygiene : *a*) What points should be considered in the selection of a breed for permanent adoption. *b*) How is it possible to combat in practice the tuberculosis of livestock . What experiments have been made in various countries in this respect ?

International Exhibition and Congress of Social Economy. Buenos Aires, September 1924. — Programme (provisional). Part. I Public Museums and similar Institutions , Part 2 Labour questions, Part 3 Hygiene. Part. 4 Education and instruction , Part 5. Agricultural problems , Part 6. Special.

The Agricultural Section will include : 1) Comparison between the importance of agriculture, commerce and industry in the various countries (international questionnaire) ; 2) professional agricultural syndicates and their relation to mutual and agricultural co-operative societies , 3) relation between mutual and co-operative societies, the co-operations and the professional syndicates , 4) agricultural credit system , 5) colonisation schemes ; 6) organisation of international trade with agricultural products ; 7) principles which should influence the organisation of agricultural instruction , 8) Agricultural Colleges and instruction in domestic farm management for women and its importance from the agricultural standpoint.

The congress will cover a period of 15 days. Those taking part should make application before the end of October 1923, and notify the subjects which they suggest for discussion during the proceedings. The pamphlets (not more than 8 pages) and the reports (not more than 4 pages) should be dispatched before March 1st, 1923 to the Museo Social Argentino, Maipu 126. Buenos Ayres, Republica Argentina (in Spanish, French or English).

International Horticultural Congress at Amsterdam (Holland), September 18-22, 1923. — Secretariat: International Tinnbouw Congress. Bergiveg, 55, Wageningen (Holland). Programme: *September 18.* Opening

of the Congress. Speeches by Mlle Prof. Joh. Westerdijk (Boarn, Holland), Prof. Blaaw (Wageningen), M. Krelage (Haarlem), Prof. L. Daniel (Rennes), Dr. Hatton (East Malling, England), Dr. O. Schindler (Dresden) on grafting. A visit to the show Dinner and mayor's reception. — *September 19.* Excursion to Aalsmeer and Haarlem — *September 20* Speeches by Royal Hort. Soc (London) Wisley; K C van Nes (Apeldoorn), Landscape Architecture; Prof. Punnett (Cambridge), *Lathyrus* hybrids Prof. Tschermak (Vienna), *Primula* hybrids; Dr Turedi (Buda-Pest) Instruction, K. Dilling (Zutphen), School gardens, F. Oldewelt (Amsterdam) Popular gardens; Daily Mail Federation of Young Farmer Clubs. Dinner. — *September 21.* Boat excursion to Boskoop. Evening reception at the Ministry at the Hague. — *September 22.* Excursion to Rotterdam Excursion to Westland.

International Congress for the Control of Olive Pests at Nice, October 1923. — As the result of the decision made at the International Olive Growing Congress at Marrakech (Morocco) in November 1922, it is proposed to hold an International Congress to study the control of Olive pests, especially the olive fly, at Nice in October 1923. All inquiries should be addressed to M. H. Latière. 71 rue de la Procession Paris.

World's Dairy Congress October 1923. — Inquiries should be addressed to the World's Dairy Congress Association, Star Building, No. 426 Washington, D. C.

The chief objects of the above Congress are the promotion of an international exchange of views regarding the latest scientific and technical discoveries affecting the dairy industry, and all the schemes relating to milk production and consumption, the study of the scientific and economic forces governing the industry and affecting home and foreign trade in dairy products, the discussion as to the different methods of supervision and control together with their application, with a view to obtaining sound, pure products; the influence of dairy products upon national health and their vital importance to the development of a people.

Report of the Congrès de la Production coloniale (Stock raising in the French Colonies). — The questions discussed at this Congress include: organisation and selection of stock in Northern Africa; transport and conservation of meat and of stock; manufacture of conserves; production and classification of wools in N. Africa and the Sudan, classification, preparation and utilisation of hides in the colonies; utilisation of colonial by-products for foods

Several communications have been received from M. DECHAMBRE with reference to the utilisation of cakes in the Colonies as a stock feed; from M. VELU on the sanitary conditions and the antiseptic precautions, in particular the use of arsenic; from M. CHENICAN on the preparation and utilisation of hides; from M. FAUCHÈRE on the transport and conservation of flesh and stock in Madagascar; from M. GRAU on the advisability of extending sheep raising, particularly the Merinos in French West Africa and Madagascar, The propositions approved by the stock raising section and the Congress as a whole may be summarised as follows.

I. That the local authorities encourage stock raising in districts where the climatic conditions are favourable; that the attention of breeders be drawn

to the possible utilisation of cross breeds and especially those made with females chosen from French breeds.

II. That the attention of the public service be drawn to the utility of washing tanks for the general upkeep of the herds and especially dipping tanks.

III. That the branding with the iron system be abolished, and any other brands likely to damage the skin; that it be understood clearly that a damaged skin loses $\frac{3}{4}$ of its commercial value; that the gastrophilus tests and the study of the gastrophilus organism be encouraged, that a dirty and badly dried skin soon falls into a state of rot. (*Revue de Zootechnie*, No. 11, pp 128-134, figs. 4. Paris, 1922).

International Olive Growing Congress at Marrekech. — Arranged for November 26, 1922, The various olive growing countries (France, Spain, Italy, Algeria, Tunisia, Morocco) were represented at this Congress including also Japan. In addition to the meetings for discussion, the programme of events included also excursions to the olive groves around Marrakech and the plantations at Oued Tessaout, Oulod Khallouf, Demnat, Camelet el Djedid, El Kelaa, and the Mesfiona. Secretary General M. H. Latière 71 rue de la Procession Paris).

Conference Week on Sheep and Wool at Berlin, December 1922. — The "Norddeutsche Schafererwerbband", organised a Conference week on sheep and wool in December 1922 at Dessauer Strasse 14, Berlin in connection with the Club der Landwirte: *December 13* meeting the to discuss of question of sheep rearing for mutton, *December 14*, meeting to continue the discussion including also the question of breeding sheep for wool. The same day, a meeting of stock owners and stock breeders was arranged with view to the regulation of prices of sheep at the public auction sales (*Mitteilungen der deutschen Landwirtschaftsgesellschaft*, No 49, p 728. Berlin. Dec. 1922).

Exhibitions and Meetings.

Commercial Fair at Brussels. — April 9 to 25, 1923, in conjunction with the International Rubber Exhibition

International Exhibition at Milan. — The Exhibition, which will take place this year from April 12-27 under the patronage of H M the King of Italy will be held for the first time in permanent premises and will also include an important agricultural Section for which the programme is as follows:—
1. A Horse and Cattle Show; 2. Special competitions for Motor Culture and different types of agricultural machines, 3. Conferences of the National Associations of the holders of the Diplomas of Agricultural Colleges Directors of Travelling Agricultural Schools, and Co-operative Associations; 4. Demonstrations of the more highly developed forms of Co-operation, especially as regards the trade in and transport of products; 5. All the means of protection and improved facilities secured for transport and storage.

The Ministry of Agriculture has empowered the Committee to make awards in the following sections: Forage crops grown for seeds selected from natural and artificial meadow land, Cereal crops; Fruit trees; Flowers; Agricultural Machinery

From April 24 to 27 the Rabbit and Poultry Show will be held

Sixth International Tobacco Trade Exhibition. — Olympia (New Exhibition Hall). May, 1923. Organised by "Tobacco", Monument Station Buildings. London E. C. 4.

International Exhibition in Western France. — May to October 1923 at Le Mans (Saathé). The exhibition will include Agricultural Machinery, foods and beverages.

Exhibition of Mechanical and Electric Apparatus at Ghent. — This exhibition, which is international in character will be open from June to October 1923.

International Horse Show. — Olympia, London. June 23 to 30, 1923.

IIIrd International Agricultural and Industrial Exhibition. — Riga (Lithuania). July 22 to August 5, 1923.

International Fair at Antananarivo (Madagascar). — August 15 to Sept. 15, 1922: rice threshers; milk (condensed and dry); margarine, tea, cheese, biscuits and jams, implements, spades, shovels etc.; cotton and flax fibre, lubrication oils.

International Horticultural Exhibition. — The "Fédération des sociétés horticoles du Canton de Genève" will hold an International Exhibition at Geneva, September 5 to 13, combined with an International Competition in horticulture (flowering pot plants, conifers, etc. for, at least one year the property of the exhibitor); horticultural industries (garden furniture, decorations, watering and heating apparatus, models of glass houses etc.). Entries before January 1, 1923. Inquires should be made to the General Secretary, S. Wolff, Le Pavillon, Grand Saconnex, Geneva.

Exhibition at Caracas (Venezuela). — In April 1923, an Exhibition of the products from Coffee and cacao plantations will be held. The exhibition will include also exhibits of machines and implements imported and used in connection with coffee and cocoa. General Secretary, Victor V. Maldonado, Caracas.

Exhibition of Seed Wheats and Machinery in Argentina. — The Ministry of Agriculture of the Argentine Republic May 5-13 1923 has cabled to the International Institute of Agriculture to state that an exhibition has been arranged of seed wheats and machinery for cleaning, sowing and selection of seeds and also machines for milling and bread making. Machine manufacturers and grain merchants will be allowed a free permit at the customs; and no charge will be made to exhibitors. In cases where agents are not available, exhibitors may ask the Ministry to act as representatives.

XXXth Agricultural Exhibition at Hamburg (Germany). June 7-12, 1923. As in preceding years, there will a Seed Show held simultaneously in Hamburg. At this Show, only seed passed by the Deutsche Landwirtschafts-Gesellschaft or Societies and Institutions in co-operation with the D. L. G. will be accepted. All types of cereals, legumes, beets and other seeds may be entered.

Agricultural and Horticultural Exhibition at Göteborg (Sweden) — During the Jubilee festivities to be held this year at Göteborg, an agricultural exhibition has been arranged for June 19-24, 1923 and a horticultural exhibition for September 14-23. As a general rule only Swedish

exhibitors can enter, but foreigners may also be allowed (with the consent of the governing committee), to exhibit in groups 8 (forage plants and chemical fertilisers), 10 (agricultural machines and implement), 11 (agricultural science and statistics), and also in classes 195-214 (dairy utensils and apparatus) Foreigners will, however, be expected to enter their exhibits through an agent or representative living in Sweden. The horticultural exhibition will be open to Norwegians, Swedes, Danes and Finns. Other countries are requested to enter new seedling species only, which had been exhibited or introduced into trade previous to January, 1920.

Pan-Russian Agricultural Exhibition. — The Commissariat of the Russian Agricultural Ministry proposes to organise a Pan-Russian Exhibition of Agriculture and minor industries, to be held from August 15 to October 15, 1923. The object will be to demonstrate: 1) the present state of agriculture in Russia, 2) the possibilities of development of agricultural industries; 3) results obtained through agricultural science throughout the world; 4) advantages to Russian agriculture which can be supplied by foreign industry. It is proposed to classify the exhibits under the following headings: agriculture, forestry, stock breeding, land settlement, exportation, industry and agricultural equipment in other countries, peasant handicrafts. Several conferences will be arranged dealing with agricultural and allied subjects, including a discussion on dry farming, it is hoped that foreign representatives will attend. Prizes will be awarded for the exhibits which will be transported to and from the exhibition hall at a tariff reduced by 50 % and duty free.

Italian Exhibition of Land Reclamation Work. — A National Exhibition of Land Reclamation Work will be held in Rome under the Patronage of the King of Italy and with the Prime Minister, the Hon. B. Mussolini as Honorary President. The Presidents of the General Committees include the Ministers of Agriculture, Public Works and the Home Office, and the membership the most representative men in politics, science and administration.

The executive Committee has been formed under the Chairmanship of Commendatore Camillo Valle, President of the National Federation of Land Reclamation Undertakings, and included among the members are representatives of the Home Office, the Ministers of Public Works and Agriculture, the International Institute of Agriculture, delegates of Financial Corporations, the Municipality of Rome and the "opera Nazionale dei Combattenti" (National Assistance for Ex-Service men). During the period of the Exhibition — which will also serve as a complete demonstration of the activity displayed in Land Reclamation Work by the Departments of Land Reclamation, Agriculture, Agricultural Credit and Home Colonisation, and Public Health — two conferences will be held for the discussion of legal questions relating to Land Reclamation, and the progress of schemes and their importance as regards various aspects of the problem; lectures will also be given, dealing with the technical side of the more important questions arising in connection with the work.

The Exhibition will have several sections, including the three Departments referred to above, the Land Reclamation Corporations, Private Land Reclamation Works, Land Reclamation in the liberated provinces, the Water

Commission for Venezia and Mantua and Land Reclamation under the Government of Tripolitania, the latter as an example of Colonial needs

The Exhibition will be of more than purely national interest and the International Institute of Agriculture will see that its importance is realised in countries other than Italy. A complete series of pamphlets will give publicity to the importance and necessity of work of this nature to which the Exhibition itself will bear signal testimony

Date of exhibition to be fixed later.

A Show confined to single animals registered in the Herd book as Normandy breeds. — The Académie d'Agriculture de France was notified at its meeting on December 20, 1922, of the recent institution probably for the first time in France, of an annual local cattle show exclusively reserved for pure bred animals registered in the Breedherdbook and including both cows and bulls and belonging to breeders resident in the district of Bayeux (*Comptes rendus des séances de l'Académie d'Agriculture de France*, Vol XVIII, No 38, Séance December 20, 1922).

Miscellaneous.

The use of the Cinema in Agricultural Education, among farmers is suggested in Great Britain, and a Society is understood to be preparing a set of films. In France, the Ministry of Agriculture has submitted to the President of the Republic an order authorising an annual grant of 500 000 frs for the purpose of installing in agricultural colleges and schools and in the rural communes, cinematographic apparatus which would be used for the popularisation of scientific agriculture. In Italy, the use of the cinema for agricultural propaganda has been largely developed through the National Institute "Cerere", Rome, Via delle Finanze, 15-21

This Institute is concerned with technical agricultural instruction and the intensification of crop yield, the films are lent free of charge (except for cost of carriage) to all agriculturists who make application to the Director of the Institute

The "Schlesische Landbund" in Germany has organised a Committee which will deal with agricultural films under two groups, one of which will deal with the photography and the other with the exhibition of the films in the Agricultural Colleges and Societies. The subject of the first film is the treatment of potato tubers in the control of diseases

Practical Work for Agricultural Students in Germany. — The students at the Agricultural College (Landwirtschaftliche Hochschule), at Berlin desire to obtain practical experience in the country during the spring vacation, and a special bureau has been organised for this purpose.

Radiotelephonic market news service in U. S. — The entire area of the U. S. east of the Rocky Mountains and practically all of the Pacific coast area from Washington to southern California is covered with daily broadcasts of Federal market reports by high-powered radiotelegraph. On Dec 1, 1922, nearly 80 radiotelephone broadcasting stations were sending out on definite schedules each day market reports, which they receive either direct from the branch offices of the Bureau of Agricultural Economics or from broadcasts which are copied from the high-powered radio-telegraph stations.

Questionnaire on Pig Breeding in the United States. — The Ministry of Agriculture in the United States, started in November, 1922 an inquiry on pig breeding. The enquiry will cover all the States and will in future be made twice a year. It deals chiefly with the number of pigs born in the year and the number of deaths through cholera and other ailments.

Propaganda for the Encouragement of Wheat Production in France. — Report adopted by the Comité national du blé. A Wheat Conference is proposed to enable an opinion to be formed of the best manures, cultural operations, seeds etc for a given area, to urge the various associations to develop their activities in every possible way; to extend methods of publicity by means of almanacs, advertisement, pamphlets, postcards, lectures, shows etc.

It is proposed: To institute a standard prize for merit, in the name of the Ministry of Agriculture at the departmental shows, to establish co-operative societies for seed production and associations for agricultural equipment, to extend the sale of seeds and seed markets organised by the Associations and Agricultural Offices, the extension of demonstration plots etc, easily accessible, continuation of propaganda schemes by means of almanacs and simple pamphlets, organisation of a wheat conference, centralisation by the Comité National du blé of investigations and results obtained in the various Departments. RABAYE L. (Inspecteur général de l'Agriculture) (*Journal d'Agriculture Pratique*, Year 86, vol 38 (New Series), vol II, 1922, No 38, pp. 249-250 Paris, 1922).

The Journal of Pomology. — Will become the official organ of the horticultural research stations in Great Britain, and the name of the Journal will now be *Journal of Pomology and Horticultural Science*.

Meteorological Bulletins by Wireless telegraphy. — A wireless Weather Manual has been published by the Meteorological Office of the Air Ministry. It is a guide to the reception and interpretation of weather reports and forecasts distributed by wireless telegraphy in Great Britain.

ORIGINAL ARTICLES

THE HIGHER AGRICULTURAL EDUCATION OF THE FUTURE

Nearly every country in the world possesses at the present time a system of Higher Agricultural Education representing in each case the most advanced stage of specialised instruction

The actual role of this form of education as well as the question of organisation are the subjects of much controversy. Consequently unless active measures are taken without delay, it appears that agricultural education in certain countries is faced with a serious crisis. It seems therefore desirable to determine clearly the ends which should be pursued in these higher studies, so that they may be brought into line with the present general requirements of agriculture.

To judge from prevalent opinion, particularly as shown in Belgium, two opposing points of view are expressed in the quarters most closely concerned. Higher agricultural education as at present organised has been accused of being too theoretical so that the student is not kept sufficiently in touch with the realities of practical work. For example, it is stated that "the training provided at the agricultural colleges is much too scientific; it inspires the farmers' sons with too progressive scientific aspirations, and instead of preparing them for rural life tends rather to alienate them from work on the land".

For those who hold this opinion, the ideal function of the Colleges is to give careful theoretical and practical instruction in the most approved cultural methods to students preferably themselves

originating from the classes directly interested in the cultivation of the soil and thus to train practical scientific agriculturists who will in the future, by their example and influence, stand out as leaders in agricultural progress.

This desire to attract students from the country districts leads to the following characteristics in the arrangement of the programmes of study — comparatively easy conditions of entry, limited duration of the course, a constant effort to give a practical bias to all the branches of instruction (including the basic sciences), the predominance of practical work on the farm and in the fields, over laboratory and lecture work.

The contrary theory is represented by those who consider that the function of higher agricultural education is not only to train students who will disseminate the knowledge of the progress already attained, but also, and more especially to prepare pioneers, research workers, and the moulders of future agricultural progress. With this object in view the courses at the agricultural colleges, leaving aside all questions of professional training, should develop still further the scientific side and definitely take their place amongst the recognised higher University studies.

The writer during a long professional career has become convinced that, agricultural education can best serve the special interests of agricultural science and the general interests of society by following the latter course.

The history of the great discoveries, which during the last fifty years have brought about the transformation of the art of cultivating the soil, hitherto in its rudimentary and empirical stage, into a complex and scientific industry that shows at each step the marks of the direct influence of pure science. Similarly the discoveries made by chemists and physiologists in their laboratories towards the end of the last century have resulted in the establishment of fundamental laws which determine animal and plant production, while purely abstract biological theories are being utilised at the present time, as a basis for experimental work for still further enhancing the productivity of the soil. It is certain that the patient and laborious researches of MENDEL, followed up and developed by a multitude of experimentalists, are the real source of the first definite stages of actual knowledge in the mysterious realm of heredity. Through the mutation theory of DE VRIES and the pure line selection theory of JOHANSEN, the Mendelian theory of heredity, still further confirmed as it has

been by recent cytological research is dominant in the field of genetics, that most fruitful branch of biology, without which animal and plant breeding would be the merest empirism.

Viewed from another standpoint it must also be acknowledged that the purely theoretical work of mycologists and entomologists, by the light that it has thrown on the evolution of parasites in all its most minute details, has led to the establishment of a scientific basis for the methods of control of plant diseases and pests. Lastly, the peculiarly delicate investigations of bacteriologists and biologists have already begun to throw a certain light on soil microbial life and are opening up a prospect of interesting and profitable applications.

Everywhere and always, pure science constitutes the active source from which, although often it may be by long and devious paths, true practical progress is surely derived. The first stages in this development are multiple. The theory itself is almost invariably the work of scientists which is in no way concerned with the utilitarian aspect of the research work on which they are engaged. It is the affair of less original minds, with a more practical bias, to grasp its possible bearing as regards practical application. Then comes the testing of the new theory, and the stage of practical experiment and finally the general diffusion of the newly acquired knowledge amongst those to whom it is of importance.

However this may be, in any attempt to determine the part played by teaching institutions and research in furthering the great work of the scientific reform of agriculture it must be admitted that the aim should be, preeminently to secure the necessary liaison between pure theoretical science and practice and to select from among the original abstract theories of laboratory experts, the ideas that lend themselves to practical application, testing and adapting them to the actual requirements of agricultural technique and finally and above all, to arrange for their general diffusion. The creative side of such institutions, although entailing much expenditure of time and energy has been regarded, as a general rule, as of relatively minor importance.

The reason for this situation is to be found chiefly in the method of recruiting professors and research workers, as it is too often the case that less importance is given to high scientific qualifications than to technical skill on the "practical" side, without which, so it is said, any branch of science however far reaching, often remains sterile in the sphere of application.

The result is that too often the duly qualified leaders of agricultural progress, are not, owing to their lack of sufficient scientific training, fit to undertake original research even under favourable conditions. No other result could well be expected, seeing that the nursery where they were trained and whence they are often far too exclusively recruited, *i. e.* the institution for Higher Agricultural Education, is often marred by the same fundamental defect.

On the contrary, the march of agricultural progress might be made far more rapid and sure, and much of the labour, expense and trouble of testing and trials might be avoided if our agricultural scientists were given a superior equipment of pure science and could go direct to the original sources of the great discoveries for the maintenance of their activities.

Surveying the great problems in the light of their practical knowledge, and directing from the outset the resulting theories towards practical applications, they would cause science to become in the applied sphere, even more highly productive.

In the writer's opinion, the most urgent need of to-day is rather for true scientists, competent to achieve success in original research, rather than for able technicians or merely popular lecturers. The responsibility for training such men lies with higher agricultural education but if the work is to be adequately accomplished, higher agricultural education must develop and improve its methods and organisation in at any rate many countries.

If the ideal scheme for training such highly qualified advisers on agricultural science and practice be considered, it will be seen that the course may be divided into two sections: a general scientific preparatory training, and professional instruction proper. The first, owing to its specially comprehensive nature is the outstanding characteristic of agricultural instruction, briefly, it includes the various branches of mathematical, physico-chemical, mineral and biological sciences.

In each of these fields, it may be considered that the agricultural student should receive a training in no way inferior, either in range or standard, to that required for a degree in pure science. In the writer's opinion the bias in the direction of "practical application", which is so often abused in the methods of scientific teaching preliminary to specialisation, constitutes a serious danger, as it tends, under the pretext that they are abstract and devoid of any practical interest, to the sometimes almost complete neglect of entire sections

of science, such as might ultimately be found to provide a source of important practical applications. Such a theory tends to encourage imperfectly qualified students with a limited horizon and sphere of interest, who will always be incapable of carrying out original research to advantage.

The University with its great thinkers and vast and precious teaching resources, is undoubtedly the most favourable milieu for the purely scientific training of the agricultural scientists of the future.

It should not be difficult, by means of judicious interchanges in the programmes of the different faculties to establish an ideal form of complete preliminary instruction, leading up to the special agricultural studies.

The agricultural scientist of the future in the next stages of his training course would thus be enabled to build up his purely professional instruction on the solid foundations of the sciences in general. It is at this stage only that the professional faculty or, in other words, the Higher Agricultural Institute enters into the field. Situated in the country and in rural surroundings, where at every point the instruction can be refreshed and invigorated by practical demonstration, the Institute with its experiment farm, its research stations staffed with eminent scientists should prove a focus of applied science in direct and constant touch with the great general intellectual centre provided by the University town from which, consequently, it should not be too far distant.

The organisation of the programmes of study and the method followed at this Institute will not be inspired by the essentially abstract conceptions of pure theory, but the far more tangible and living requirements of science applied to practice.

In order, however, to safeguard, from the point of view of its specialised character, the type of education which is required, various dangers must be avoided. In certain special schools, though classed as of the "Higher" rank, there is a tendency to make the professional instruction degenerate into a kind of technical initiation into the practice of such and such a branch of agricultural industry or speculation. Under the guise of exercises in the adaptation of theory to practice, the student is required to carry out processes and manual operations, which could be far better learnt after the completion of his studies during the course of the stage which every student should pass through before starting on his professional career.

The subject of practical application in Higher professional instruction should take the form of training the student how to observe, measure and analyse, to complete his knowledge by means of documentation, and to initiate him into experimental method and individual research. Such studies, it may be added, should tend to occupy an increasingly important position in the time table as their teaching value is inestimable. It is pre-eminently in the study of practical applications and tutorial work that the professor will find his chief opportunity for acting as initiator and revealer, it is at the point of contact of theory with fact that he will best be able to show his mastery and acquire that moral ascendancy that will make his pupil respect and honour in his person both Science and professional ability. This is also the stage when he can most readily inspire the student with the love for research and the method to be pursued, by arousing his curiosity either in the progress and results of his special work or in other subjects equally capable of serving as a basis for original study. In short, the sphere of practical applications will give the professor the means for establishing on more solid bases than those of an examination, a sound appreciation of the value and real knowledge of a student.

For the student himself, the practical exercises will provide the opportunity of obtaining the most solid and lasting form of knowledge, of developing his spirit of initiative and testing his capacities and of gauging personally his degree of attainment. But, as already stated, the object of demonstration work and practical exercises must remain always at a high standard, as the period which the student can devote to his higher studies is too precious to be spent in carrying out work of a purely technical nature.

Another danger to be avoided in the higher agricultural course is in the writer's opinion the tendency towards an exaggerated specialisation. Agriculture viewed as a whole, undoubtedly occupies too vast a field to allow any individual to make a complete scientific study of all its branches. The agriculture of temperate and tropical countries respectively, forestry, horticulture, livestock, chemistry, technology and farm engineering, all form special branches of which an intensive study can be made with the object of training special classes of scientific agriculturists.

It is necessary however, to safeguard the general agricultural training which an extreme specialisation would jeopardise and to avoid turning out men with an incomplete equipment, who although

well-trained in the minutest details of some particular branch, remain, owing to their insufficient knowledge of general methods and broad principles, incapable of seeing, understanding and adapting themselves to what takes place outside the narrow limits of their own accustomed sphere of activity

A high level of preliminary scientific education, a far-reaching general professional training and a moderate degree of specialisation, such should, according to the views of the writer, be the qualifications which the agricultural scientist of to-morrow should be expected to supply

It should be at once admitted that at present such a programme is already, at any rate in its essential lines, being carried out in several countries. Such countries have realised that the day of a relatively easy victory and diffusion of knowledge is ended and that for wresting from nature the secret of new wealth and for realising the imperious claims of impoverished humanity in this troubled post-war period, for an increase in the productivity of the soil, an ever increasingly urgent appeal must be made to the aid of Science as the only true generating force of progress.

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AGRICULTURAL METEOROLOGY AS A FIELD FOR INVESTIGATION

There are few questions which have more continuously occupied the attention of mankind than the attempt to establish some connection between weather and crops. Primitive man in all ages and regions has hoped to control as well as to forecast the weather, his methods and opinions are wrought into the ritual of his religion. Every country possesses its weather lore embodying traditional correlations of weather and vegetation

Yet despite the universal and secular character of the observation devoted to it by farmers, even though in primitive times the existence of the community might depend upon the prediction and though in more civilised epochs vast sums of money might be made by successful forecasting, little real knowledge has been obtained especially in countries like Western Europe, possessed of variable weather rather than of a settled climate. In ancient Egypt the Priesthood gained its power by its ability to foretell the rise of the Nile; what position might not have been attained by men who could have predicted the character of the Indian Monsoon? It was not until systematic records of weather began to be kept that material for the study of correlations between weather and crop prediction were obtainable and even then but little could be made out from them. Probably Sir NAPIER SHAW'S paper of 1905 marked the most definite step in this direction. He showed that the average yield of wheat in England could, in 5 seasons out of 6, be predicted with some accuracy from a consideration of the rainfall in the previous autumn. Taking 39.5 bushels per acre as a maximum, deduct 1.25 bushels for every inch of rain that fell in the previous autumn, and a close approximation to the average crop of the year will be obtained for the great majority of seasons. The foundation for the wheat crop is laid in those months and only in some exceptional seasons does some weather factor in

the later development of the crop overthrow the edifice which could normally be erected on the foundations laid down in the earliest stages. What value would Sir NAPIER SHAW's rule not have been to a wheat merchant or speculator in the earlier days when the price of English wheat was determined by the home production and not by the world's crop. Sir NAPIER SHAW's generalisation was a year or two later followed by Mr. R. H. HOOKER's investigation of the correlations to be found between the weather and crops of the East of England, and the method he employed of correlation has been extended by other investigators, of whom we may mention WALLEN in Sweden, WARREN SMITH in the U. S. A. and JACOB in India

This, broadly, is the field of agricultural meteorology — ultimately to predict crop yields from the weather prevailing during their growth. Bound up with the problem, is the determination of the effects of this or that weather element in the growth of the crop at various stages, and weather forecasting itself. It is for example, possible to forecast the occurrence of night frosts and to make provision against them by smoke screens, during the critical period when fruit blossom is setting.

The cultivation and manuring of many crops might be varied to advantage, if one could predict the general character of the weather even a month or two ahead.

From the work already done there appear to be three methods of investigation open. The first, which is purely empirical and depends only upon the analysis of the records available of past happenings, is to trace the existence of some periodicity in crop production and in weather. Many attempts have been made to determine cycles in cosmical phenomena and to ascertain their effects upon weather, the best known examples being perhaps BRUCKNER's period of 35 years and the sunspot cycle of 11-12 years. The difficulty is to obtain data of sufficient accuracy and duration to permit of exact mathematical discussion. One of the most interesting of these attempts is that founded upon an examination of the annual rings of growth of the giant Sequoias of California. As is well known, a tree puts on a ring of growth every year which by its colour and structure can be differentiated from the rings formed in previous and succeeding years. In an ordinary way by counting these rings we can determine the age of a tree that has been sawn across and polished so as to yield a clean section. But we can go further, for the breadth of the ring along any radius varies and affords a measure of the growth made in that

season and that growth represents a rough summing up of the character of the weather as favourable to vegetation or otherwise. DOUGLASS (1) summarises the results of the examination of the rings of about 450 sequoia trees of which the great majority are over 1,000 years of age and as many as 79 over 2,000 years. He finds that the correlation of growth with rainfall is greatest when a period of years is taken, the best results being obtained when a three-year period is taken for trees in dry situations and a ten-year period for trees in moist situations. There is a lag in the movement of the rainfall to the soil in which the trees grow and owing to the natural storage of water in the soil it is only the cumulative effect of several seasons that is reflected in the growth of the tree. Sir WILLIAM BEVERIDGE is attacking the same sort of problem from another angle. Records exist of the price of corn on various markets in Western Europe for the last four hundred years. Up to about 1870 when ocean transport began to develop so extensively and wheat began to arrive in Europe from the Americas, these prices represented the local yield of crops, for there was no means of relieving local scarcity by importation on a large scale or of passing off a superfluity to less favoured districts. These prices can be made to afford an index of production with the proviso that there is a certain cumulative effect to be taken into account. An abundant harvest in one year will produce a carry over which will mitigate a scarcity in the succeeding season, or two or three consecutive unfavourable seasons will so exhaust the stores as to result in something approaching a famine. Given such data, what remains is a prolonged mathematical discussion which will eliminate the cumulative effect and reveal the existence of recurring cycles of good and bad harvests.

Indeed, Sir WILLIAM BEVERIDGE's preliminary discussion seems to indicate the existence of several minor cycles as well as or perhaps resulting in a major cycle for which there is strongest evidence, which has a period of about 15.3 years. Of course the subject is fraught with difficulty, for scarcity is not the result of one factor, it may on one occasion be due to drought, on another to excessive and long continued rainfall, it may again be caused by mistiming of otherwise favourable elements. There may be distinct cycles for the different weather elements, say of drought or of rainfall, and as these cycles are not necessarily of whole year periods their recurrence may be

favourable or the reverse according to the season at which they happen. For example a period of drought in the late autumn or winter will be favourable to winter wheat, whereas a similar drought in April-May might injure the winter wheat and practically wipe out the spring wheat crop, which is the main source of supply in Eastern Europe. A heavy autumn rainfall is most adverse to the subsequent yield of winter wheat, whereas the same amount of rain during the growing period might, if followed by good harvest weather, build up an abundant yield. It is known that Sir WILLIAM BEVERIDGE is pursuing his investigation of this class of data. Other analogous materials may be found which will repay examination and may lead to the detection of broad weather cycles that will be helpful towards production in the future.

The tracing of cycles deals only with the broad resultant effect of all the elements of weather. Mr. HOOKER's method attempts to discriminate between them and to trace the effect of each upon the final crop. Moreover, he divides his year into periods of 8 weeks, so that his results indicate the effect of an excess or deficiency of the element at particular times of the year upon the size of the crop. His data are the statistical records of crop yields in the East of England for a period of 21 years beginning in 1885 (since extended to 35 years), and these he correlates with the rainfall and temperature records for the same district. He determines the correlation coefficient not only for the year of growth, but also for the preceding year, the weather of which is often found to have a marked connection with the yields in the subsequent year, even if the crop had not then been sown. For example, with the wheat crop wet weather in late spring and dry weather in the later summer are moderately correlated with a good yield, but dry weather in the autumn and late winter are much more favourable. Cold in late spring is associated with a good yield, but the favourable effect of heat in the previous summer and early autumn is even more marked. It is clear from Mr HOOKER's results that the same weather elements are not equally favourable for all crops in the East of England. Most of them benefit by a dry previous winter, but in late spring the weather requirements of wheat and potatoes are reversed, dry hot weather being favourable to potatoes, whereas wet and cold conditions are associated with good wheat crops. One cannot study Mr. HOOKER's results without beginning to speculate upon causes. One can see a variety of reasons why a dry warm autumn should be favourable to the sub-

sequent wheat crop. In the first place it makes for good cultivation, the seed is put in on a good tilth and not plastered into mud. The average date of sowing is earlier, because the farmer can get on with his operations and in England early sowing is favourable to a good yield. Germination is more rapid, bacterial actions producing plant food are favoured, the plant gets established before the winter. Again, a dry winter is favourable in that it induces an extensive root growth, which renders the plant more independent of subsequent drought. In a wet winter with a saturated soil the root development is curtailed, the plant has a smaller volume of soil from which to draw either water or nutriment, and thus becomes more liable to lodge when the heads become heavy. Many such causes may be traced more or less imperfectly, some are first hand — the direct action of the weather upon the growth of the plant, others are secondary in that the weather is favourable or adverse to the incidence of disease or the fostering of weeds. Some are still more remote such as the effect of weather on the farmers' application of labour. A protracted harvest one year may throw many of his operations out of gear in his preparations for not only the next year's wheat but for his other crops

The correlation method has the advantage of making no hypotheses as to causes, it reveals the frequency with which one set of facts, facts in the nature of results, tend to be associated with another set of facts which may or may not be causative. Obviously the claim of causation is strengthened if from another side evidence can be adduced to explain such a sequence. And this leads us to the third class of investigations that are necessary in agricultural meteorology. We may attempt the intensive study of a given crop in its response to the weather conditions under which it is growing, in order for example to ascertain the meteorological factors which are significant in its development. We are all in the habit of using the expression "a growing day". What elements constitute the combination which makes for vegetation? Moisture in the soil, humidity, temperature, illumination, are all likely to play their part; can we establish by experiment the optimum conditions and their dependence one upon another? The problem is inevitably complex because the effect of some elements such as temperature is not always positive. Growth may increase with rising temperature up to a point when further increases become unfavourable and the effect is negative. Again, any one of the elements may become a limiting factor; for example, water supply and temperature may be sufficient

but growth may be limited by deficient illumination. What are the limiting rates for each of the elements when the others are at their optima, and which of them are likely to be operative under average conditions? The investigation is not an easy one, even the choice of a test plant presents difficulties. If we are measuring vegetative development, we can take as index the increase in length of a shoot, or even weigh the dry matter produced in a given time. But we have also to take into account the age of the plant and the amount of previous development. If a plant has grown well during its first stage it will be the better able to make use of favourable conditions in the second period; in other words weather conditions favourable or unfavourable have a cumulative effect on the final production. Still, these difficulties can be overcome and when working on a small scale, the weather factors may to a certain extent be controlled so as to reduce the experiment to a single variable. We might for example be able to maintain water supply and illumination at an optimum and determine the effect of temperature. Even then the problem presents further difficulties because vegetative growth is only one part of crop production. We can for example, by excessive supplies of nitrogen compounds enormously increase and prolong the vegetative development of the wheat plant but it does not follow that we can, under normal conditions of climate, obtain a corresponding increase of grain. The plant may prolong its growth until the season does not permit of much grain formation, or of its ripening. In the case of the winter wheat crop we can distinguish three or four distinct periods of development, each demanding its own weather conditions. In the autumn and winter, root development is all important, for which as we have seen a comparatively dry soil is favourable. Next follows the vegetative period proper of above-ground growth. Then the plant enters upon the stage of migration, when the material accumulated in leaves and stem is moved therefrom and remade in the grain. This period overlaps the former one, for in an English type of climate, at all events, assimilation of material from the air and from the soil does not cease with the formation of grain, though it gradually runs down to a minimum before the process is complete. In continental climates with high summer temperatures the stage is probably more sharply defined. There is evidence that warmth is favourable to the migration process, on the other hand it may be curtailed by excessive dryness. The migration process merges into the last stage of mere ripening, when from the physiological

point of view the weather can affect the gross yield but little, but when frost, excessive rain or wind may have a serious adverse effect upon the commercial yield.

One of the fields for investigations thus becomes the determination for each crop of the critical periods of its development and the particular weather conditions that are dominant in each period. The work then becomes associated with investigation by the correlation method, because it becomes possible to concentrate attention upon the critical periods and to establish a causal instead of a merely empirical connection between the crop production and the weather.

Intensive investigation of the kind under discussion may also lead to the further knowledge that is needed concerning the meteorological data to be obtained, in order to be of service in the study of crop production. It is uncertain whether those at present collected by meteorologists are such as have the most bearing upon the development of vegetation. Rainfall has for examples two effects, it determines the water content of the soil upon which depends the water supply to the crop, and it influences the humidity of the air, which again affects the development of the plant. Clearly the distribution of the rainfall as well as the absolute amount within a given period is a factor, but it is not obvious how to use the rainfall records so as to translate them into figures bearing directly upon plant growth. It may be desirable to obtain records of the moisture in the soil, though it is difficult to establish the unit of measurement in view of the variation induced by the nature of the soil itself and its situation. As regards temperature, the usual data provided are the daily records at 9 a.m., the maxima and minima, and less generally the traces given by self-recording instruments. From these with more or less accuracy the accumulated temperature in hour degrees above a chosen datum line may be calculated, but research is still needed to determine which is the best figure to use as having a causal connexion with plant development. Again as regards humidity, we have in the first place to choose between dew point determinations and the percentage of possible humidity. When, again, within the day should the humidity be determined or should some integrated figure representing the average humidity of the day be aimed at? Some measure of evaporation may prove to supply a better measure of the effect of the atmosphere upon the plant than humidity determinations.

As regards radiation our ignorance is even greater. Sunshine

records are generally available and it may be of more service to determine total solar radiation. Beyond a certain intensity sunshine may have a negative effect upon vegetative growth, inasmuch as it induces the closing of the stomata, and the partial suspension of transpiration and respiration.

These are all question upon which the plant physiologist, working intensively upon the individual plant, must reach some conclusion before the investigator applying the method of correlation can know what meteorological data are necessary to him, as being causally connected with crop development.

Some further consideration must also be given to the data for crop production, which the investigator of agricultural meteorology has to use.

With few exceptions statistics of crop production are estimates obtained in each country from a corps of observers, more or less trained for their work. Like all estimates the results are subject to certain general errors of which the most important in this connexion is probably their tendency to smooth the actual curve of varying yield. Big crops are under-rated, while the yield is often over-estimated in bad years. The effect of this is to obscure the correlations that would otherwise be obtained, at any rate to blunt the sharpness of the conclusions that could be drawn. It has been suggested that a much more exact index of production could be obtained if in the Country in question some convenient number, say, 50, of farms were selected, suitably scattered over the country, reasonably typical of their district and stable in their management, and the actual yield per acre for the standard crops were measured on these farms. The mean of the yields thus ascertained would give not perhaps the true yield per acre of the country, but an index figure that would vary from year to year with the true yield, a figure which might represent with a degree of accuracy, depending upon the number and choice of the measurements made, the fluctuations in production of that country in response to seasonal fluctuations. An index figure so obtained would be valuable not only to the investigators of meteorology but to statisticians generally. The question is however too general for discussion here.

Enough perhaps has been said to show that the question of data is of prime importance in the still infant science of agricultural meteorology. It is a difficult subject in which for some time to come progress is not likely to be rapid, but for that progress above all

investigation is necessary. The meteorologists are still in the main waiting for a lead from those concerned with the agricultural side of the problem, and that lead can hardly be forthcoming until further research has been carried out on the reaction of the crops to the various elements of weather.

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SOIL AERATION

The fact that plant roots require oxygen has been a matter of general knowledge for more than a century. It is also well known that carbon dioxide in strong concentrations is poisonous, not only to animals, but also to plants, although from weak solutions of this gas plants derive a large part of their food material. A study of these facts makes it evident that sufficient aeration of the soil is required for the growth and development of plants, although this does not necessarily imply that aeration is a subject to which the agriculturist must devote special attention; the degree of its importance depends upon the extent to which the plants cultivated are tolerant to infra-normal concentrations of oxygen and of supernormal concentrations of carbon dioxide in the soil; the intensity of oxidation in the soil, the activity of the gaseous exchanges with the air at critical periods, e. g., those that are least favourable to good aeration. As regards, all these points there is still much ignorance.

Another matter concerning which we are no better informed is the effect of different cultural operations upon the intensity of gaseous exchange, although as a result of practical experience, it is generally recognised that care must be taken to encourage the access of air to the soil and to remove any difficulties in the way of its circulation. SORAUER appears to have been the first to lay stress upon the importance of soil aeration. In the first edition of his book on the Diseases of Plants, he already (1874) attributed certain injuries to deficient air supply and recommended measures for its improvement. Among the diseases which are now definitely attributed to lack of free circulation of air in the soil are beetroot rot and the "brusone" of rice. At the present time, the question of soil aeration is much to the fore, especially in India. At the Pusa Agricultural Research Institute, HARRISON and ARYOR found in 1913, like BRIZI in Italy, that the roots of rice-plants require a certain amount of oxygen in the water surrounding them.

The oxygen is supplied to the rice plants by the respiration of a layer of algae that normally grows on the inundated soil of the fields ; should the formation of this layer be disturbed, as for instance, by the too frequent renewal of the water, the rice crop suffers. Since this was discovered, the aeration of the soil has become a matter of paramount interest at Pusa. Not only have several widespread diseases of cultivated plants (Javan indigo, peach-tree) been attributed to lack of air in the soil, but it is believed that the normal yield of crops can be increased by measures tending to assist aeration, such as a system of irrigation in which little water is used. Thus, in India, soil aeration is not only important to agriculture in extreme cases, or under extraordinary conditions, but also affects normal production, being really the limiting factor. It is too soon for any general application of these results, especially to temperate zones, although it appears probable, at first sight, that the circulation of air in the soil would be a more important factor in torrid zones than here in Europe. The exuberance of plant growth, both in and upon the soil in the tropics where it is stimulated by the moist, hot climate, necessitates a more thorough aeration of the soil than is required in temperate zones, in order to maintain the usual proportions of oxygen and carbon dioxide. Therefore, it is not surprising that the many experiments carried out in Europe for instance, amongst other places at the celebrated Station at Rothamsted, England, should not have given results showing that cultivated plants normally live near the aeration limit. Indeed, even in India, LEATHERHEAD, basing his opinion on careful analyses, has expressed himself sceptical as to the truth of the generally received opinion, which attributes the effectiveness of ploughing to the improvement of the circulation of the air in the soil. In the course of my researches on forest ecology, I have been led to interest myself in the question of soil aeration in general. In silviculture, no less than in agriculture, the air supply of the soil has come to be regarded as an increasingly important factor. The rôle of SORAUER in agriculture has been played in silviculture by GRÄBNER who attributes the infertility of soils containing crude humus mainly to their insufficient aeration. Since forest soils of this description are very common in Sweden, especially in the north of the country, I propose to examine their aeration. Crude humus does not appear to hinder the circulation of air, but on marshy land where the soil consists of moist humus, the aeration is undoub-

tedly very defective, and the scanty growth of the forests on such soils may be largely attributed to this cause.

In order to be in a position to discuss the results I had obtained in different soils and to be able to compare them with the data of other investigators, I felt it was necessary to examine the mechanism of aeration and determine the air supply needed to maintain the required amount of oxygen and carbon dioxide in the interstices of the soil. I therefore attacked the whole pedological problem of aeration, thus obtaining results affecting the agricultural side of the question, as well as the sylvicultural side. In this paper the points that appear to be of general interest will be reviewed and the results considered from the point of view of agriculture. For all details, the reader is referred to my Memoir published in the *Bulletins of the Swedish Forestry Research Station* (ROMELL, 1922), to which is appended a summary in German. An account of this work appeared in the *International Review of the Science and Practice of Agriculture* No. 1257, 1922.

The normal amount of aeration in a cultivated field may be estimated by taking the carbon dioxide present as an indicator and the following facts as a point of departure. It has often been observed (FODOR, WOLLNY, BORNEMA) that the carbon dioxide content of the air near the soil, between the green leaves of the normal plant growth which is developing and assimilating carbon dioxide in the full sunshine, is higher than the normal, and exceeds that of the air above the plants. This means that the carbon dioxide production of an agricultural soil is at least equal to the consumption of CO_2 by the plants at the time of their most rapid growth. By means of agricultural crop statistics, the amount of CO_2 liberated by a soil per unit of space and time can be estimated. I have used the figures of SJOSTRÖM, at Ultuna, near Upsala, which show the average weight of the dry matter of different fruits to vary between 600 and 900 kg. per week and per hectare during the months of August and September. These figures correspond to 13.2-19.8 gm. or 7-10.5 litres of carbon dioxide given off by the soil per day and m^2 at 15°C ., the temperature at which all the following determinations were made. STOCKLASA and ERNEST, who took other factors as their basis, estimated at 13.5 gm. the amount of CO_2 produced by the soil of a wheat field per day and m^2 . In the case of forest soils (central Europe) these investigators obtained even higher figures. Some estimates made on the spot by LUNDEGARDH,

in the alder and beech-forests of South Sweden, showed 2.5 litres per day and m^2 , as the CO_2 production of the soil. Some determinations made personally, in a beech-forest in South Sweden, using LUNDEGARDH'S method (with one important modification) gave an average of 2.8 litres of CO_2 per day and m^2 from the soil, in June.

From these different volumes of CO_2 obtained, the actual normal aeration of the soil was estimated by comparing them with the normal, or directly determined CO_2 content of the atmospheric air and of the air present in the interstices of the soil. In this way it was discovered that for 7 litres of CO_2 to be given off by the soil, per day and m^2 of surface (these figures refer to cultivated fields), it would be necessary for the soil to be completely aerated once an hour from the surface to a depth of 20 cm. For the locality studied, in this instance a beech-forest, the CO_2 content was directly determined at three different depths. If these results permit of generalisation, the actual amount of CO_2 present in the air of the soil interstices must be regarded as expressing an equilibrium between intense production and very effective liberation viz., very thorough aeration. Upon this fact is based the modern idea of carbonic acid fertilisation, and many observations tend to prove that the state of affairs shown by these calculations is the normal condition, this indeed was the case as regards the statements made long ago by FODOR concerning the remarkable effect exercised upon the CO_2 of the atmosphere by the amount of this gas given off by the soil. The liberation of CO_2 may be regarded as an indication of aeration in general, for there is no reason to suppose that the resistance of the soil is radically different in the case of the in-flow of oxygen and of the out-flow of carbon dioxide. Returning to the figures giving the CO_2 production and content which we summarised above, it can be estimated, on the basis of the localisation of the biological activity in the soil as found by WAKEMAN, what change in the CO_2 content would cause the complete cessation for a certain time of any liberation of the gas produced. According to these figures, the CO_2 content from the superficial layer to a depth of 20 cm. should be doubled in $1 \frac{1}{2}$ hours, and increased ten-fold in 14 hours, merely by the production of this layer, if the gas continued accumulating at the rate calculated and had no outlet either above or below. From these results it was concluded that *normal aeration would be essentially effected by factors of continuous action*, and not by very markedly intermittent factors, such as the wind, for instance.

If this were not the case, the changes in the CO_2 content of the air in the interstices of the soil would be far more abrupt and extensive than they are found in reality.

The opinion of pedological and meteorological experts (RAMMANN, MITSCHERLICH, HANN), however, is not in agreement with these results. Quite an unimportant part is attributed to diffusion which is the sole continuous factor that can be taken into consideration. In order to clear up the matter, a theoretical quantitative estimate of the efficacy of all possible factors has been made. The full explanation is given in the German summary of my Memoir mentioned above, where it occupies 53 pages.

It was impossible to deal with the matter more briefly without making it difficult to comprehend, therefore it is obvious that all that can be given here is a simple enumeration of the results obtained.

The factors to be considered may be grouped under 5 heads: *temperature, atmospheric pressure, water, wind and diffusion*. In the case of each factor, I have compared its calculated ventilating effect to that of the complete renewal once an hour of the air contained in the superficial soil layer 20 cm in depth. This will be called in future "normal aeration." The following is a summary of the results of these comparisons.

Under *temperature* are included two different effects, the one due to the changes taking place in the volume of the air in the interstices of the soil owing to the periodic variation of temperature, and the other caused by the soil being heated to a higher temperature than that of the atmosphere above it. The first effect is very slight, indeed, I have calculated the diurnal variation during the season when it is greatest and found it to range from 1/600 (forest) to 1/800 (exposed field) of normal aeration. The result of the annual variation is even less — about 1/900 of normal aeration. The effect of the soil becoming heated to a higher temperature than the superincumbent air is extremely difficult to calculate exactly. I have been obliged to confine myself to the maximum possible effect. This figure varies greatly according to the texture of the soil. In the case of coarse-textured soils such as ploughed clay, the maximum effect during the most favourable season may be very great and can attain every degree up to normal aeration. On the other hand, in finer and more compact soils, the maximum effect quickly becomes negligible. In

the case of a perfectly dry moving sand, the maximum effect during the most favourable season does not amount in Sweden, according to my calculations, to more than $1/200$, and probably not even to $1/100$, of normal aeration.

The effect of *barometric changes* is proportionate to the depth of the soil layers filled with air. Taking this at 10 m., the average effect of meteorological conditions in our part of the world is about $1/200$, but in torrid zones, it may attain an average of $1/100$ of normal aeration. If the air-filled soil layer is only 1 m., instead of 10 m. in depth, the figures obtained would be one tenth of those given above. If, however, the deeper seated air-filled strata of a very porous soil are covered with a layer of less porous texture, barometric variations will proportionately increase the possible aeration of this superficial layer.

Rain-water, on entering the soil displaces a corresponding amount of air and the same quantity of fresh air gradually finds its way into the ground as the former level of the water-table is re-established. Under the meteorological conditions obtaining in Sweden, this action on the part of the rain must, according to my calculations, bring about the renewal of the air once every three weeks in the superficial layer of soil 20 cm. in depth, and thus effect $1/500$ % the normal aeration. This calculation involves 10 % of the soil being filled with a normal volume of air. Where the pores are larger the figures will be still lower. During a short time in the spring, just when the ice and snow melt, the effect of the accumulated water which has fallen throughout the winter suddenly makes itself felt and gives rise, at the moment of most rapid fall of the water-table, to an aeration amounting to $1/20$ of the normal aeration (figures obtained from observations in the north of Sweden).

The ventilating action of *wind* is due to the pressure and suction produced on surfaces sloping towards the direction of the wind. It is therefore, intimately connected with the configuration of the ground which determines for any given wind velocity the values of the pressure exerted, as well as the length of surface upon which it acts, that is to say, the gradient of the pressure in the soil. Even if this gradient is given, the aerating effect is, however, not yet determined. It is necessary to know the resistance the soil offers to the passage of the air. This varies greatly with the size of the particles and the compactness of the soil. It is thus clear that no general calculation can be made of the effect of wind on soil aera-

tion, but in certain special cases, the maximum value of the average effect has been estimated. In the case of a fallow field with soil composed of large particles and ploughed in such a manner that the space between the furrows measured 30 cm., the ventilating effect of the wind in the soil between the furrows (taking the wind conditions prevailing on the plain of Upsala) was several times greater than normal aeration. The wind action on a dune of moving sand exposed to the gales of the Baltic sea was able to produce $1/16$ to $1/4$ of normal aeration. When the calculations were made for forest soils, quite a different scale of values was obtained viz, in one of the most favourable instances, $1/3000$ to $1/1000$ of normal aeration, although the estimate was based on the full force of the wind sweeping across the plain of Upsala and not abated in any way by its passage through the forest. Since the power of the wind is always greatly reduced in the interior of great stands of trees, it may safely be asserted that, as a general rule, wind plays no appreciable part in the aeration of forest soils.

On the subject of *diffusion*, some very detailed investigations were made, because my first calculations convinced me that the ventilating effect of this factor must be of the same order of importance as normal aeration, and further, *its action is continuous*. Hitherto, diffusion had usually been regarded as a factor of no importance. At first, it had the reputation of being a "*processus lent*", subsequently, it was considered (RAMANN) that it could in any case play a very small part in aeration, since the difference in the composition of the air in the soil interstices and that of atmospheric air is generally small, so there is only a low gradient for calculation. But the effect of diffusion, when expressed in a manner permitting of comparison with that of the above-mentioned factors, is *independent of gradient*. Only the amounts actually transported depend on the gradient, and thus vary with the content at a given depth. This, however, is the same in the case of all the other factors. The absolute quantities of oxygen and of carbon dioxide with which the soil is enriched, or of which it is deprived, as the result of the complete renewal of the interstitial air to a certain depth, are clearly connected with the previous CO_2 content of the aerated layer. There is no difference in this respect in prejudice of diffusion.

In order to judge of the effectiveness of diffusion as compared with that of another factor, or of "normal aeration", it is neces-

sary to know 1) the value of the diffusion coefficient ; 2) the distribution of activity in the soil According to the experimental work of HANNÉN and of BUCKINGHAM, the coefficient of diffusion varies little in the cause of soils of the most different textures, unless the soil is very wet, or very compact and composed of extremely small particles. The normal variation is about 0.05 to 0.11 cm²/second. This is a coefficient of *apparent* diffusion that can be used for the total diameter of the pores in the soil calculated from its porosity ; the theoretical value is higher As soon as the dimensions of the soil spaces approach the size of the free path of the air molecules, about 10⁻⁴ mm., the diffusion process is no longer normal For this reason, the normal coefficient cannot be used for a soil with very fine compact particles such as those of a heavy clay. The writer repeated an old experiment made by FLÆSK and calculated the apparent diffusion coefficient for a small block of dry, compact loam without any cracks, to be 0.00044, or about 1/100 of the normal coefficient

Diffusion is very slow in damp soils of any texture, and practically ceases if the pores are completely filled with water This is not surprising, since the rate of diffusion of CO₂ in water is only 0.00002 cm²/second.

The distribution of the soil activity has also a distinct influence on the rate of diffusion. The more the activity is concentrated in the neighbourhood of the surface, the greater the effect of diffusion as compared with that of the other factors. The vertical distribution of the bacteria in soil has been accurately calculated layer by layer by WAKSMAN (see figs 34 & 35)

The results obtained for the different soils examined agree very well, and it has therefore been assumed that the curve traced by WAKSMAN represents a normal condition, at all events for cultivated soils. By translating the number of bacteria directly into consumption of oxygen and production of CO₂, a somewhat arbitrary proceeding it is true, and supposing the porosity of the soil to be the same in all the layers with which we have to do, the following was obtained for the excess CO₂ $p + = \% CO_2 - 0.03$, and for the oxygen deficit $p - = 21 - \% O_2$; the curves of which are both similar to the curve reproduced in Fig. 1. By completing this curve graphically, the curve in Fig. 2 was obtained, in which the ordinate of any point represents the total excess carbon dioxide (CO₂ +) and the total of the oxygen deficit (O₂ -), from the surface

to the corresponding depth. With the supplementary table to the left, it is possible to calculate from this curve, figures comparable to the aeration effects previously calculated. Thus, in order to get what we call normal aeration (the exchange in one hour of amount

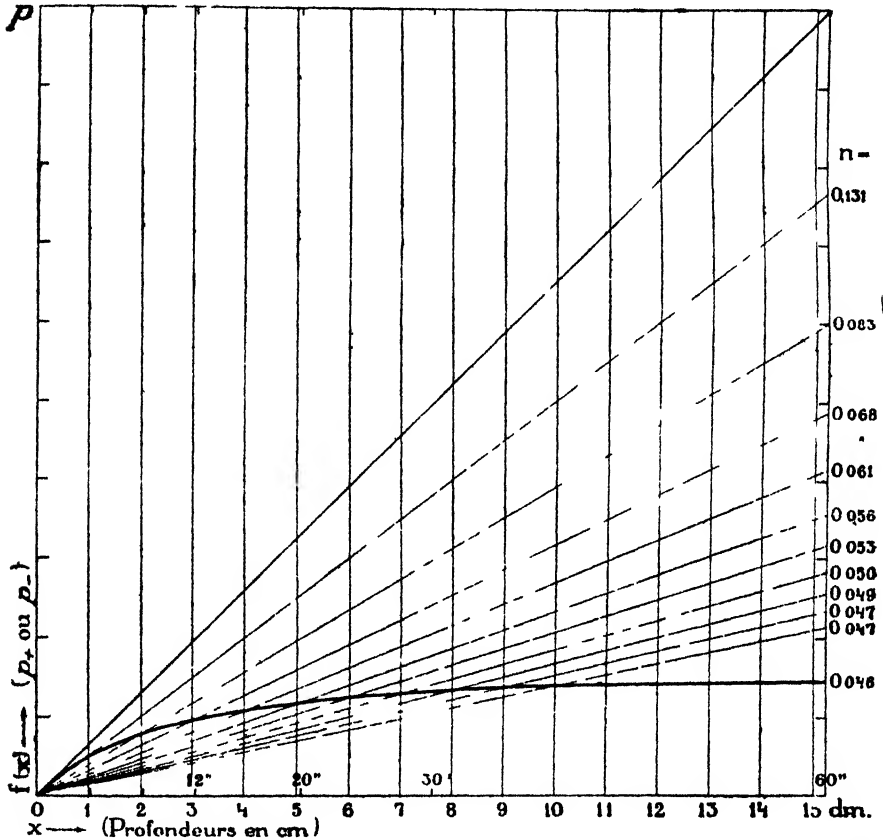


FIG 34 — Curve showing the variation, with the depth, of the values $p+$ and $p-$ (excess CO_2 and O_2 deficit in % of volume) in a soil of homogeneous porosity, the distribution of activity in the soil being estimated according to the bacteria counts of WAKSMAN (the figures n to the right are to facilitate the calculation of the slope of the soil surface starting from the value of $p+$ or $p-$ at a given depth $pn/100 =$ the slope required in atmospheres per cm, $p = p+$, or $p-$, in % of volume. By multiplying by the diffusion coefficient, we obtain the quantities transported to the surface in cm^3 per second, and cm^2 of the total diameter measurements of the pores.

corresponding to $\text{CO}_2 +$ and $\text{O}_2 -$ in the superficial layer to a depth of 20 cm.), it is enough to calculate with a diffusion coefficient of 0.04. With a coefficient of 0.10, the same aeration is effected in 20 minutes, instead of in one hour, while the result of one hour's

aeration would correspond to values of $(\text{CO}_2 +)$ and of $(\text{O}_2 -)$ from the surface to a depth of 35 cm

It must therefore be concluded that the normal aerating effect of diffusion for the first 20 cm taken together exceeds "normal aeration." From what has been stated above, it is possible to count upon such thorough ventilation due to diffusion in the case of homogeneous soils of any texture or degree of porosity, provided the said soils are not very damp and are extremely fine-grained and

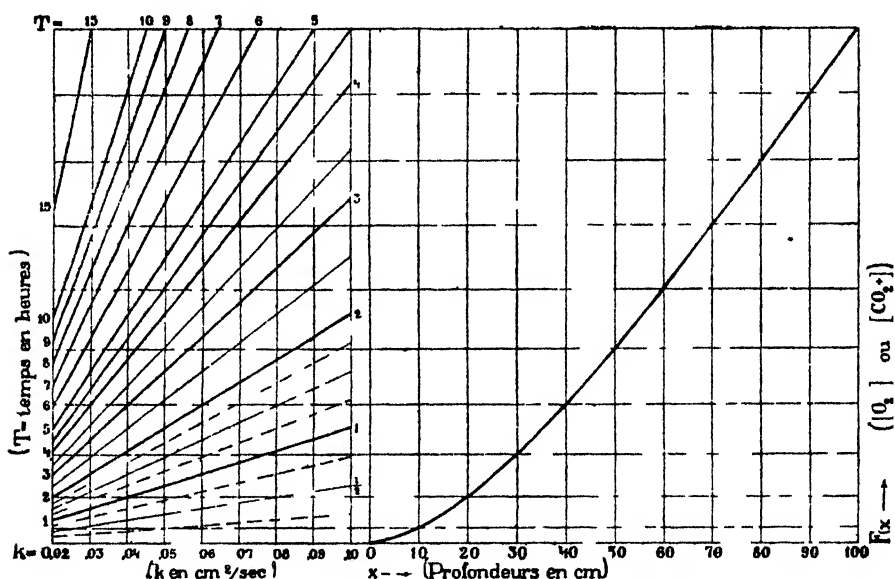


FIG 3. — Curve in Fig 1 completed so as to give the total amount of excess CO_2 and of O_2 deficit $(\text{CO}_2 +)$ and $(\text{O}_2 -)$ respectively between the surface of the soil and various depths under the conditions represented in fig 1. The additional table to the left permits of the curve being directly obtained for different values (k) of the diffusion coefficient the time necessary for aeration to the different given depths and inversely, the diffusion coefficient corresponding to the different given intensities of aeration

compact, the process is moreover, perfectly continuous. None of the other factors have given such a favourable result, except under more or less exceptional conditions.

The result obtained is thus very favourable for diffusion, which may be considered to be one of the most important aerating factors for every kind of soil. For this reason soil aeration is described as entirely a diffusion process, and it is shown how to calculate the state of aeration whatever may be the porosity of the soil, or the dis-

tribution of bacterial activity. For these calculations, the reader is referred to my above-mentioned memoir, where he will also find the details of my comparative research on the effect of the various factors which have been briefly described in this article.

The reader who has followed this summary closely, will certainly have taken exception to my method of expressing the results of the comparisons in the form of a fraction of normal aeration. No doubt a factor of which the aerating action is limited to the upper layer of a few millimetres in depth (like the effect of the day temperature) may reach the same figure as a factor which works to a great depth but very slowly. The importance of the two factors is, however, naturally very different, the first being more effective in the superficial layer and the second in the deeper-seated strata. The value used as a measure of comparison viz, the complete renewal once an hour of the air in the superficial layer to a depth of 20 cm is also somewhat arbitrary. If the "normal" renewal of the air during one minute, or one day, had been taken as the measure, the figures used for comparison would have been more or less different, but the depth figure of 20 cm, which is entailed by taking the hour as the time unit, is of the right size to permit of a comparison of practical utility. The superficial layer to a depth of 20 cm is throughout its whole extent the seat of intense activity, whereas bacterial action soon becomes negligible at greater depths. Thus, the measure chosen is perhaps not so arbitrary as it may appear. As regards the comparisons, even with this measure, they are given in more detail and more clearly in my above-mentioned memoir than in this article.

If the soil is homogeneous, its porosity and total activity do not come into the calculations in a research on the relative importance of diffusion. These data are, however, of paramount importance from the ecological standpoint. It is true that, if only the distribution of the activity in a soil is given, the aeration is the same in the case of soils of different degrees of porosity and total activity, should the aeration be measured by a comparison of the amount of gas transported with the total quantities of $\text{CO}_2 +$ and $\text{O}_2 -$ in the soil layer under discussion. But the O_2 and CO_2 contents existing at different depths in the state of equilibrium, vary with the total activity and the volume percentage of air in the soil. The percentage values of excess CO_2 and of O_2 deficit will be, at any depth, in direct proportion to the total activity and in inverse

proportion to the volume percentage of air in the soil. Therefore, in order that the excess of CO_2 and the deficit of O_2 may not exceed, at any given depth, the values prescribed for the total activity of a given soil, it is necessary for the soil to be more porous where the activity is more intense. If in a soil which had at the beginning a homogeneous porosity, this porosity should be reduced in the superficial layer to $1/n$, let us say, of the original value, the values of $p+$ and of $p-$ would increase in this layer n times, further, $p+$ and $p-$ would increase with a constant value throughout all the underlying layers where the porosity had not diminished. Thus the obstruction of many pores in the superficial layer would be sufficient to affect the composition of the air contained in all the layers of the underlying soil

The results obtained will now be examined from the practical standpoint. From numerous analyses of the air contained in the soil, as well as from theoretical investigations, I have come to the following conclusions as regards the forest soils of Sweden 1) the whole aeration is practically due to diffusion, 2) aeration is as a rule, sufficiently general in the *podzol* soils in their natural compact condition, even if a very thick layer of crude humus is present beneath the mineral soil, 3) good aeration does not depend on the work of earthworms nor on a crumbly texture, 4) the very favourable effect often noticed after the partial breaking up of the soil of crude humus land is not due to improved aeration, 5) as a rule, aeration is defective in damp soils, and is likely to be insufficient in clays. All these conclusions must not, however, be directly applied to agricultural soils, or to soils in general. There are inherent and great differences between forest soils and agricultural soils which affect directly the problem under discussion. The same treatment cannot be applied in every case.

Even if it were actually useful to break up the soil of a forest every year, this would be a doubtful procedure from the economic standpoint, since the production would not repay the expense. Agricultural soils can, and are, worked annually, whether or not it is necessary for their aeration. This enables them to be kept more or less porous and of the required texture, they are, in fact, always maintained in an artificial and free-working state. In the case of forest soils, indirect measures alone can usually be employed; these produce a semi-natural and almost stable condition.

The other differences are connected with the one just mentioned.

Forest soil, being always in a state of equilibrium and sheltered by a covering of dead leaves and plant débris, is not subject to the abrupt changes in compactness which affect agricultural soils that are always relatively bare. A single shower of heavy rain can perceptibly change the aeration conditions in a field where the clay soil has been carefully broken up and will destroy the tilth and make the surface layer heavy and compact. In extreme cases, after the rain has fallen, a continuous layer of stiff clay with isolated particles will be formed. The normal condition of an agricultural soil is the mellow state produced by the intimate mixture of mineral soil and humus, but in forest soils of the *podzol* type, there is a layer of crude humus at the surface, underlain by an almost pure mineral soil made up of isolated particles. Agricultural soils are more exposed than forest soils to wind and to the heat of the sun. The velocity of the wind in the forest is only a fraction of the speed of the wind sweeping across fields.

All these differences produce variations in the conditions of aeration. On account of its effect and continued action, diffusion must certainly be regarded as the most important factor of aeration also in agricultural soils, but here, in certain cases, two other factors play a large part. In an agricultural soil composed of clods such as a clay that has been broken up, the spaces between the fragments are of fairly large size and the resistance offered to the passage of a current of air through the soil is sufficiently slight to allow the minimum pressures produced by the action of the said factors to induce a very considerable amount of aeration (see above, under *wind* and *temperature*). Too great general importance in aeration must not, however, be attributed to wind and heat. Thus, for instance, RUSSELL and APPLEYARD, in the course of their extensive experiments, have been unable to find any connection between wind and the composition of air in the pore spaces of the soil. They concluded that there was nothing to indicate that the composition of the air had been affected by the wind. A current of air might have been expected to aspirate the air of the soil, but apparently it does not have this effect (*Journal of Agricultural Science*, 1915, p. 34).

The greatest obstacle to good aeration, even in agricultural soils, is undoubtedly the infiltrated water. The soil meatus, when filled with water, is practically blocked, for in water, the rate of diffusion is only about 1/10 000 of what it is in air, while all the other factors except diffusion are without any effect.

In the second place, it is the lacunar space in the soil which is important, whereas the dimensions of the meatus are secondary, for we have seen that within very wide limits, the effect of diffusion does not depend upon the size of these passages. The important matter is the relation between the activity and the lacunar space of the soil. As it is not in the interests of the agriculturist to diminish soil activity, he must be careful to insure the necessary degree of porosity. The higher the activity, the greater the amount of porosity required. The breaking up of the soil is thus especially desirable when a liberal supply of manure has been spread, and the climate is hot.

The size of the soil meatus would be of paramount importance if the wind etc. played a great part in aeration, as it would then be necessary to leave the soil in large clods and not to pulverise it, although the process would increase its porosity. In order to promote aeration by diffusion, the first point to be considered is porosity, the size of the meatus can be to a large extent disregarded. Another point that must be remembered is the probably bad aeration of the large fragments in a heavy soil. Well-worked garden-mould is known to be the habitat of anaerobic bacteria, such as the tetanus bacillus, and according to RUSSELL and APPLEBYARD, there are normally two atmospheres in every soil, one being that of the meatus and the other the air contained in the clods, or absorbed by the particles. The latter is always poor in oxygen and rich in carbon dioxide, even when the soil is well aerated. Thus, by breaking up the large clods, the useful space where aerobic bacteria thrive is increased. On the other hand, soil of too fine a texture holds an excess of water and can in consequence become badly aerated, therefore it would not be rational to reduce a heavy soil to powder. The more a somewhat stiff soil is worked, the worse it becomes, so that heavy rain has increased power of perceptibly altering its conditions of aeration. This does not refer to the waterlogging of the capillary tubes, for if the land is well drained this effect is but temporary; rain however renders soil compact and does away with its open texture; the finest material is in suspension in the water. After rain has fallen, the soil will have a compact, continuous superficial layer, formed of isolated particles and covering the more or less intact strata. Although this crust is very thin it has a considerable effect in hindering aeration for, as we have already said, diffusion goes on very slowly in a material with such extremely

fine pores (for instance, 1/1000 of the normal size). Moreover, the clay layer retains the water for a long time which further decreases the aeration. As a precaution against this effect of rain, SORAUER advises that the soil be covered with straw litter, or some similar substance, in order to break the force of the impact; this seems a reasonable suggestion and in default of litter, the surface of the soil might be left covered with fairly large clods to prevent the texture being so quickly destroyed. Wide channels might also be made into which the water could drain off, in which case the superficial crust would not form so easily.

Unsatisfactory results are often obtained by planting too closely, both in agriculture and horticulture; SORAUER ascribes them (and probably rightly) to the insufficient aeration of the roots. If the roots are planted too deeply, some of the oxidising activity in the soil is displaced downwards, which lengthens the path of diffusion. The values of the O_2 deficit and CO_2 excess to which the roots are exposed necessarily increase, even if the activity of the roots remains the same. Further, the radicle system of plants, especially of trees, that have been deeply planted often extends into less porous and damper layers of soil than those reached by the roots of individuals growing nearer the surface.

Recently, a system of combined drainage and aeration of the soil has been devised in Germany which appears to have been successful when applied to wet, badly-ventilated land. The advantage of the new method is undoubted, but its effectiveness may probably be attributed to the good drainage and not to the ventilators with which the waste-water channels are supplied. The most serious hindrance to satisfactory aeration is the presence of excess water in the soil, therefore the removal of the useless water is the surest way of attaining better ventilation. On the other hand, as soon the excess water is drained off, normal aeration by diffusion is very effective, provided the soil is not particularly fine grained and extremely compact, in which case any aeration produced by the displacement of the air in the soil is practically out of the question, since the resistance is enormous and the pressures that can be brought to bear are small. Thus it appears to be impossible for the suction action of the chimneys to cause any appreciable filtration of fresh air through the soil. If, however, the drainage pipes were very close together, it might be possible for the gaseous exchange resulting from diffusion between the air in the drains and that in

the surrounding soil, to play some part in conjunction with the normal exchange between the atmosphere and the soil. The exchange conditions are naturally much better if a current of fresh air passes through the drains, than if the drains are blocked, a point which has been forgotten by MITSCHERLICH in his critical article (*Bodenkunde*, last edition) for the well-known scientist shares the common prejudice as to the unimportance of diffusion.

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AN ENQUIRY INTO THE QUESTION OF THE SAVING OF A PART OF THE PHOSPHATIC FERTILISERS IN GERMANY

It is well known that Germany obtained the greater part of its phosphatic fertilisers from the U. S. A., from the French Dominions in North Africa, and in the shape of basic slag from Lorraine. During the late war, Germany was able to get possession of great quantities in France and Belgium. To the loss of Lorraine and also to the continuous fall of the mark must be attributed the fact that, today Germany has at disposal only a little more than a third of the quantity of phosphates which her agriculture could utilize before the war. This third which was to a great extent derived from the iron works, is destined to decrease still more, in consequence of the decline, of the industry. As with the present depression of the mark, no considerable importation of mineral phosphates or phosphatic fertilisers can be expected, German agriculture will be obliged to restrict still further the use of manures. It is well known that Germany is not short of potassic fertilisers, although she has lost through the war, by the surrender of Alsace her original universal monopoly of potassic salts. It is true that Germany does not yet possess any excess of nitrogenous manures, although the chemical manure factories have succeeded in producing more than the amount required by national agriculture before the war. Agriculture is thus confronted by the question, whether it is possible to maintain at a sufficiently high level the yield per unit by increasing on the one hand the supply of nitrogen and potash, and on the other substantially diminishing the supply of phosphates. Opinions on the subject were at first very divergent. The zealous supporters of LIEBIG'S law of the minimum maintained that, a decrease in phosphatic manuring must correspondingly diminish the utilization of nitrogenous and potassic fertilisers and that for this reason Germany would be obliged to import phosphates at any price, so as not to increase the direct importation of food stuffs. Other experts did

not limit themselves to the strict application of the law of LIEBIG. Thus GERLACH even during the war showed repeatedly that the relation in which the three nutrimental elements, nitrogen, phosphorous and potassium were used in Germany before the war, did not in any way correspond to the quantities of the elements themselves extracted from the soil with the crops. Moreover, GERLACH demonstrated that before the war, Germany had consumed a much greater quantity of phosphoric acid, than that which would have been necessary in relation to the consumption of nitrogenous and potassic manures and the quantities which were extracted from the soil by the crops. According to GERLACH the stocks of phosphatic manures thus obtained, enable German agriculture to continue for years the manuring of the soil with greater quantities of nitrogen and potash, without essentially diminishing the yield per unit. GERLACH considered even the possibility of increasing the yield per unit by means of a more widespread use of nitrogenous and potassic manures, noting however that in this way the reserves of phosphoric acid accumulated in the soil before the war, would be more rapidly exhausted.

The present writer has been the first to point out that the problem of manuring with phosphates cannot be considered solely from the technical standpoint, but that there are certain rules of rural economy which emphasize the necessity for a farm to utilize the three kinds of manures. This view arises from the fact that almost all cultivated soils contain large quantities of phosphatic compounds, which though not directly assimilable by crops can become so gradually as the result of the application of certain processes by which they are transformed into organic compounds. The greater part of German soil contains, for each cubic metre, large quantities of the more insoluble phosphates, sufficient to provide for several hundreds of cereal crops, if it were only possible to make them assimilable by the plants.

The second fundamental point on which the present writer based his views, was his experience that several cultivated crops did not respond to phosphatic manuring although they contained great quantities of phosphoric acid in their tissues. The author who was formerly the owner of farms in Lausitz, had proved by numerous manuring tests that lupine and serradella even when grown in sandy soils poor in phosphoric acid, never in fact responded to treatment with this form of manure.

A soil test proved that the content of phosphoric acid was such

as to be more than sufficient for 200 crops of rye or 100 crops of potatoes, if these plants had been capable of assimilating it. Lupine and serradella evidently were able to do so.

It may therefore be concluded that the cultivation of lupine and serradella on a large scale, which should be partly grazed and partly used in the stables as forage, must increase the supply of phosphoric acid for the farm. The more lupines and serradella are grown on a farm, the more phosphoric acid is rendered assimilable by these plants at the expense of the phosphates in the soil which are not easily soluble. If in addition the manure is carefully saved, the floating provision of easily soluble phosphatic manures, must sooner or later become so large as to be sufficient to provide the phosphoric acid necessary for all the crops cultivated. A copious potash dressing given to the lupine and serradella, must considerably increase the readiness with which phosphoric acid is assimilated.

Similar results may be obtained by supplying nitrogen, although lupine and serradella are capable of fixing atmospheric nitrogen. It is well known that they only acquire this capacity at a fairly advanced stage of development, namely when the bacterioids by which the nitrogen is fixed and to which they act as hosts, have settled in their roots. But up to this period these plants must live on the nitrogen found in the soil and until the root nodules are formed they grow slowly and are very liable to attack by animal and vegetable pests. If at this period, a small quantity of nitrogenous manure is supplied, a phase of growth is obtained instead of one of wasting and thus the general development of the plant is assured and intensified.

The writer further proposes to answer the question whether there exist for the better soils containing lime in which lupine and serradella either do not flourish or do not give the highest yield, analogous plants whose cultivation would facilitate the transformation of the more insoluble phosphates in the soil, into phosphoric acid easily absorbed by green manure and dung.

It has been proved in the first place that good crops of clover could be obtained by manuring with potash and nitrogen instead of potash and phosphoric acid.

It has also been determined that by these means the content of the plants in phosphoric acid did not diminish sensibly. It was thus shown that meadow clover even if not treated with an easily soluble phosphatic manure, assimilates large quantities of phosphoric acid

from the soil. Hence potash manuring and an adequate application of nitrogen must convey nutriment to the plant.

Lucern is of even greater importance for limiting the requirement of phosphatic manures. As a crop which can grow on the same soil for 12 years, it is capable of a very deep penetration with its roots in all suitable soils. The object is not of course to obtain nitrogen, which it is able to assimilate by means of its root nodules even in the superficial layers, it penetrates the lower strata because there are to be found there, stores of phosphoric acid and of potash which are not accessible to other plants. These stores are conveyed in the green vegetable mass which is brought to the stables in the form of hay or herbs and pass into the dung after having traversed the digestive apparatus of the animals. If again, the dung is carefully preserved, this relatively soluble phosphoric acid is rendered available for other crops. The cultivation of lucern on a large scale and a rapid renewal of lucern fields must therefore afford an excellent means of diminishing the requirement of phosphatic manures even in the best soils. Moreover, in theory this should make it possible to avoid entirely the purchase of phosphatic manures, and it thus becomes a question of rural economics, whether it pays better to purchase part of the necessary phosphoric acid, or alternatively to cultivate lucern on a sufficiently large scale.

The third method which the writer has proposed for economizing phosphoric acid on the farms of Germany is a complete reconsideration of the manuring of the fields. In Germany, before the war the price of nitrogenous manures was very high when compared with that of phosphatic and potassic manures. It was therefore necessary by means of copious dressings of phosphoric acid and potash, to utilize as completely as possible the expensive nitrogenous fertilisers. Potassic and phosphatic fertilisers were lavishly used to secure in each case the assimilation of the nitrogenous manures. This caused the adoption of a one-sided phospho-potassic system of manuring which on the one hand favoured the development of the leguminosae which fix nitrogen, and on the other checked the growth of the gramineae. Thus in order to store nitrogen, the gramineae had to make use of that which they could obtain from the residues of the roots, which as nitrogen-fixers contained this element.

Hence the development of gramineae in the fields was poor and comparatively little hay was produced, but it was very cheap. The fields were often dressed with phosphatic manures, particularly

basic slag, but only because they were poor in chalk. Given the low price of basic slag, the principal question was not whether it acted solely as a phosphatic manure or as a chalky corrective, but how to economise in the use of the expensive nitrogen fertiliser. To-day all price relations are revolutionized in Germany, and it is necessary to restrain by means of unilateral potassic manuring, the development of leguminous plants which are nitrogen fixers and favour thereby the growth of gramineae. Thus, not only a much higher yield of hay can be obtained, but also the quantities of phosphates previously accumulated are made available.

However by this means easily assimilable phosphoric acid can be extracted from the soil, which returns to the soil in the form of dung after having passed through the digestive apparatus of the cattle.

The author has also made tests to show clearly whether it is possible to limit the need for phosphatic manures by means of the cultivation of peas, beans, vetch, lentils and other pulse crops. In this case too he substituted for the usual dressing of potassic-phosphates, the application of the usual quantity of potassic manure, with the addition of 1.5-2.5 qx. per ha. of ammonium sulphate. In this case also it was proved that with this method of dressing as compared with phospho-potassic manuring, yield was not diminished but on the contrary, often showed noticeable increase. Hence the plants were obliged to utilize equally the phosphoric acid contained in the soil, and to transfer it into the green vegetation

Further important progress in this direction was made through the author's work in collaboration with Dr. M. von WRANGELL, a lecturer at the Higher School of Agriculture at Hohenheim. Dr. M. von WRANGELL showed in the first place that the assimilability by the soil of the less soluble phosphates varies according to the crops and that for one group of field crops it is markedly influenced by the content of the soil. For example, lupines in soils relatively poor in phosphate are able to assimilate phosphoric acid to a sufficient degree, though it dissolves with difficulty in such soils because of their poverty in lime. In soils which are deficient in lime lupines make good lime requirements, by removing from the lime phosphates a part of the lime with which they at the same time decompose these phosphates and are able after absorbing the lime also to absorb the phosphoric residuum. If large amounts of lime are applied to sandy soil, lupines die through the lack of phosphoric acid. In this case they seize on the carbonate of lime and die through the excess of lime in their tissues

before being able to extract lime even from the lime phosphates which they have a difficulty in reaching. When Dr. WRANGELL gave lupines regular supplies of water soluble phosphoric acid in sufficient quantities, lime even when copiously applied was innocuous. Hence to promote a good growth of lupines it is necessary that the soil should contain only such an amount of lime carbonate as they can eliminate by absorption without entirely annulling their lime requirement. They can in such case only decompose the lime phosphate and assimilate the phosphoric acid therein contained. Naturally plants which have a high lime requirement and a strong capacity for its absorption, such as peas, beans, lucern, clover, can assimilate lime phosphate even in soils which are themselves rich in lime derivatives. They take up a large amount of this lime for accumulation in their tissues and then also seize on the lime phosphates. On the other hand, such crops as cereals, which are unable to absorb much lime, cannot assimilate directly the more insoluble lime phosphates in the soil. In relation to lime, cereals absorb great quantities of phosphoric acid and all the larger if the content in tricalcic phosphate is high. Probably therefore, cereals cannot obtain their requirement of phosphoric acid solely from lime phosphate, but other phosphates such as those of iron or magnesium or other soil constituents, are also more important for them than they are for the leguminosae.

Further Dr. von WRANGELL has shown that the absorption of phosphates by cereals is not independent of the soil reaction. In a soil with an alkaline reaction cereals have great difficulty in assimilating the less soluble phosphates, which is quite an easy matter in a soil with an acid reaction. In this case not only is the reaction of the whole soil-mass concerned, but more particularly those particles which come into direct contact with the roots. The importance of this soil reaction was shown by the Russian Scientist, PRIANISCHNIKOFF, before Dr. von WRANGELL, but chemical science did not fully realize the value of his experiments. In practice, the importance of this question of soil reaction comes out in so far as through a choice of fertilisers, it is possible to control the reaction at the point of contact with the roots. If sulphate of ammonia is applied to a cereal crop, the roots absorb the ammonia from the salt and in consequence set free the sulphuric acid in the immediate neighbourhood of the root-hairs, which absorb the nutritive matter, while the acid acidifies the soils and facilitates the decomposition of the less soluble phosphatic particles present. If on the other hand nitrate of soda

is given to the same crop the roots remove the nitric acid from the salt and leave the alkaline soda which checks the further solution of the soluble phosphates.

Among the many experiments made by Dr. von WRANGELL, those are of particular significance for practical agriculture which have demonstrated that a check to the assimilation of phosphoric acid does not necessarily imply a poor yield. A field of rye, which in spring receives a dressing of easily soluble superphosphate in addition to nitrogen and potash, at first presents a more flourishing appearance than a field that is dressed with nitrogen and potash only. In the first field the crops can easily supply their requirement in phosphates, in the other on the contrary the crops find great difficulty in this respect. If the climatic conditions are reasonably favourable the second field will not give an inferior harvest but the crop will ripen later. Hence readily soluble phosphatic manures are of special importance not merely because of the crop's requirements as a whole, but also during the early period of the growth. This point is of special importance in the case of sugar beet. The yield of sugar beet, which continues its growth late in the autumn, profiting by all the available sunlight, is diminished if at the early stages of growth it has difficulty in supplying its requirements in phosphoric acid. In this case the retardation of the early growth persists and is never made good. Beetroots differ from cereals inasmuch as their growth period continues beyond the summer.

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LEUCITE IN AGRICULTURE

The demonstration of the various ways in which potash influences plant growth is the province of the physiologists of the vegetable kingdom, but it is the work of the agricultural chemists to recognise the constant presence of potash in the ash of plants, of which it may constitute as much as 50 %, and hence its direct, or indirect, influence upon plant life and development.

The experiments of VILLE, WILFURTH, MÜNTZ and GIRARD (who proved potassium to be an element of vital importance) are well-known, as are also those of LOEB (1906), CLARK (1916) and OSBORN (1921). Until 1796, when KLAPROTH met with potassium as a mineral component of leucite, it had been regarded as an organic substance.

The necessity and importance of potassic manures, especially in the case of certain crops, did not escape the notice of those interested in agricultural science and led to the more wide-spread and intensive use of these fertilisers in countries where agriculture is most advanced, and where unit production is high and still increasing.

Civilised nations are now searching energetically for the raw materials of potassic fertilisers, not only in order to be able to supply at less cost the ever-growing demands of agriculture, but also to free themselves from foreign domination. In the efforts made by America during and after the war, the economic side of the question was not even considered, which is an instructive and warning instance (*Bull. Int. Inst. Agric.* 1912, No. 2678) of this tendency

L. O. FERRERO (*Le ricerche geologiche e le esplorazioni sottoterranee dei mezzi fertilizzanti*, Caserta 1892) was the first to suggest the use of the Italian leucitic rocks as fertilisers. After recognising the high leucite content of the Roccamonfina lavas and briefly describing the method of increasing it, he writes as follows: "It is necessary to wait until the chemical fertiliser industry learns to realise how rich these rocks are in potash and is prepared to entertain the idea that they might prove a national source of revenue".

Leucite is a mineral occurring very abundantly in Italy, not only in lavas, but also in various volcanic tuffs, and as it is only found rarely and to a limited extent in other countries, may justly be termed an Italian product. WASHINGTON estimates that the leucitic lavas of the Italian volcanoes contain no less than 9 thousand million tons of K_2O . Leucite is an important constituent of many volcanic rocks and translucent crystals of this mineral are not infrequently found in the tuff and ashes of the Latian volcanoes and of Vesuvius. Chemically, leucite is a metasilicate of potassium and aluminium $KAL(SiO_3)_2$ with the following theoretical percentage composition: potash 21.5; alumina 23.3 and silica 55.2. Sometimes the K is to a certain extent replaced by Na. The geometric form of the crystals is that known as the icositetrahedron (211) (Fig. 36), but in polarised light, leucite is slightly birefringent, positive, and shows in section numerous polysynthetic intersecting twin-lamellae (Fig. 37). When heated to about $700^\circ C.$, the mineral becomes mono-refrangent and all its anomalous optical properties disappear; small crystals are however, generally mono-refrangent, even at ordinary temperatures.

After all that has been written on the subject by VON RALH (1875), WEISBACK (1880), KLEIN (1885), MALLARD (1877), BAUMHARRER, LENBERG (1876) and others, it is unnecessary to dwell at length on the above mentioned optical characters of leucite, especially as the monometric modification is only formed and stable at very high temperatures (Fig. 38).

Leucite frequently contains gaseous, liquid and solid inclusions (augite, nepheline, plagioclase, feldspars etc.) arranged in zones parallel to the faces of the crystal, or sometimes radially (Fig. 39).

Interesting modifications in these inclusions are produced by their reabsorption and substitution by the ferruginous magma which give a peculiar appearance to the section. The formation of leucite in lava rocks has been the subject of a valuable memoir by WASHINGTON 1907, (Fig. 40).

Hydrochloric acid decomposes leucite, causing the separation of powdery silica. Leucite is very easily altered and undergoes important transformations. We are here specially concerned with the alterations that occur in leucite and leucitic rocks as a result of atmospheric agency and of the conditions obtaining in the soil, although all the epigenetic changes that have been observed by mineralogists and lithologists are by no means devoid of importance.

PLATE X.



FIG 36 — Crystal of leucite

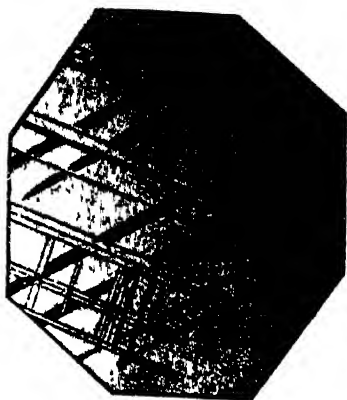


FIG 37 — Section of leucite crystal
in polarised light

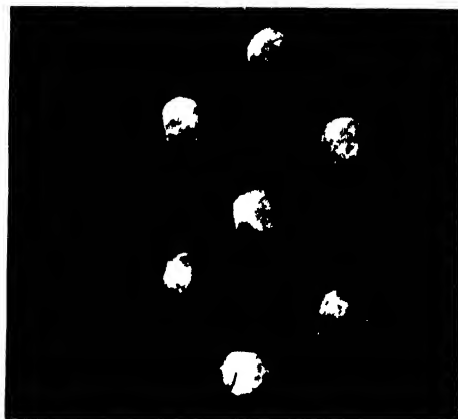


FIG 38 — Small monocrystalline crystals of leucite



1



1



1



2



2

FIG 39 — Inclusions in leucite

(1) Invasion of ferruginous magma

(2) Numerous inclusions arranged according to the symmetry of the crystal

PLATE XI.



FIG. 41 — Taucite rock



FIG. 42 Transformation of taucite into feldspar — Polished bit

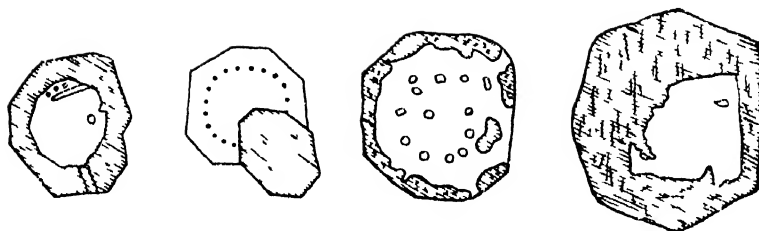


FIG. 43 — Taucite converted externally into nepheline

The most frequent reversible alteration is the conversion of leucite, to analcime $[\text{Na Al (Si O}_2)_2 \text{H}_2\text{O}]$ which was artificially obtained by LENBERG with the exchange of the bases $\text{K} < \text{---} > \text{Na}$. In the lavas of Latium and of other districts, the conversion of leucite into nepheline has been observed (Na Al Si O_4) ; sometimes the alteration begins on the outside, at others, towards the centre. Thus, secondary nepheline is formed on the exterior of the leucite crystal; it is characterised by alteration striae parallel to the prism faces, these striae are however, also present when the alteration is uncertain.

MICHEL-LEVY and LA CROIX have noticed the conversion of leucite into nepheline and into sanidine and explain the alteration by the doubling of the leucite formula (1895) (Fig. 41).

We owe to V. SABATINI (1896-1900) many observations on the transformation of the Latian leucite into sanidine and into the whole series of lime, soda, fespars, the same modifications were also met with by C. VIOLA (1896-99) in the Hercinian lavas. The transformation is so thorough as to reproduce the zoning of fespars of primary formation, the most basic occurring internally and the more acid externally (Fig. 42). The conversion of leucite into muscovite has also been mentioned. VAN HISE (1904) considers the process similar to that resulting in kaolin. He makes some interesting remarks respecting the changes in the volume of the new minerals. Other scientists, among whom we may mention, SAUER (1885), KUNZ (1886), FR. WILLIAMS (1891), HUSSAK (1892) and RUINE (1922) have also studied changes of this nature.

Experiments to ascertain the behaviour of leucite in the presence of salt solutions (sodium and calcium chloride) have been fully described. PRATOLONGO (1912) has shown the impossibility of any solid solutions being formed by the two solid components of this system under the conditions in which the absorption process takes place.

Ammoniacal leucite has been obtained by EICHORN (1875), JOANNY (1889), CLARKE and STEIGER (1900) and BERNARDINI (1908) by means of the reversible relation between leucite and the acid radicles of the salts of ammonia, similar to that existing between analcime and ammonium-analcime (FRIEDEL, 1896). The factors necessary to the above-mentioned transformations are of a nature to exclude any possibility of their generally taking place in agricultural soil.

The formation of kaolin from leucite was at first attributed to the agency of water and carbon dioxide, the disintegration being supposed to take place in two successive phases, but the latest discoveries of science show that this process is probably not of general occurrence, while the identity of the ultimate alteration products is often a matter of considerable uncertainty. No doubt the action of water and the atmosphere either singly or combined may, like that of any other superficial agents, bring about the transformation of leucite into kaolin, but in agricultural soils other factors come almost exclusively into play; of these we should first mention hydrolysis and absorption. Hydrolysis has been so minutely followed in leucite by LEPIERRE (1895) that he was able to describe its successive theoretical phases and the extent to which other agents have contributed to the results. Owing to the complex conditions obtaining in agricultural soils, it is not easy to obtain a clear idea of what takes place during the hydrolysis of leucite, though this difficulty may be obviated if we consider the isolated facts and take certain probable hypotheses as a basis.

Leucite, being a metasilicate of potassium and aluminium, the potash present may be regarded as a strong base and the alumina as a relatively weak acid, the whole forming a potassic salt of the hypothetic silicic-aluminium acid. When water dissolves the compounds, an electrolyte of a strong base, like potash, goes into solution as does the silicic-aluminic acid which however, is not dissociated. The removal of the potash allows the alumina to act as a base, and the complex acid breaks down, giving rise ultimately to silicate of alumina (kaolin) and silica (sand), *c. g.* to the two chief constituents of agricultural soil and to a vital element indispensable to plant-life.

I have been able to ascertain by repeated observations of leucitic lavas and of pyroclastic rocks containing leucite that this mineral generally remains fresh, vitreous and almost transparent if it lies beneath the surface of the soil, provided the soil is but little permeable to the atmosphere, whereas when in contact with the air, it soon changes and gives rise to different products according to the circumstances. In sandy soils that have been much washed by rain and even in agricultural soils which have been liberally irrigated, the fragments of leucite remain almost translucent, although they decrease in size owing, no doubt, to mechanical action.

I have taken some of the white powder called "caolinica" from

some pulverent leucites and found its behaviour to differ from that of kaolinite proper. Part of the powder remained for a long time in suspension in distilled water, thus indicating the presence of a hydrosol.

On repeating the experiments of ROGERS (1848) CLARKE, (1895-1900), STEIGER (1900) and BERNARDINI (1908) on the solubility of leucite in distilled water (1910-1921), I obtained positive results. The solubility of the mineral is certainly increased by several factors viz the decomposing action of plant-roots (DE ANGELIS D'OSSAT, 1910); the presence of salts of NH_4 , of Na, or of Ca etc.; the agency of micro-organisms carbon dioxide etc, all of which combined with the plant's selective action in obtaining its food supply, disturb the equilibrium that might exist between the percolating solutions in the soil. If this were not the case, these solutions would become so dilute as to be unable further to sustain plant life. It is not surprising that leucite should behave in this manner, when we remember that the micas and other minerals that are less easily attacked, have been found to give up potash to the soil (PRIANISCHNIKOW 1906, BIÈLER and CHATELAN 1910, BLANC 1912, DE TWILL 1919).

The actual chemical composition of leucite does not correspond with its theoretical composition, this discrepancy is due to the inclusions which are present in considerable numbers in the crystals and are difficult to separate out, and also to the frequent substitution of Na for K. Further, it is by no means easy to find much leucitic material that has not undergone some paragenetic alterations, or changes due to atmospheric agency.

The following table gives the results of the recent analyses of I) leucite from the deposit of Latium pyroclastic material at Tor di Mezza Via (Albano); II) leucite from the Alban Hills (PRATOLONGO); III) material from Carbogna, Cimini (CASORIA); IV) leucite in the lava of Borghetto (?) (COLOMBO).

	I	II	III	IV
Si O ₂	53.65	54.20	54.59	55.01
Al ₂ O ₃	23.40	26.07	25.02	23.01
Fe O	2.10	—	—	—
Ca O	0.63	0.18	0.16	0.34
K ₂ O	20.61 }	17.26	18.36	20.07
Na ₂ O		0.64	1.26	0.72

Several eminent analysts (BISCHOFF, RAMMELSBERG, RICCIARDI, KLAPROTH and AWDEYEN) have investigated the leucite of Vesu-

vius and Roccamonfina: the maximum and minimum results of their analyses are given below (DANA 1889).

	Vesuvius		Roccamonfina	
Si O ₂	53.37	57.84	56.32	58.10
Al ₂ O ₃	22.85	41.02	22.44	24.35
Fe O	—	0.14	—	—
Ca O	—	0.91	—	0.25
K ₂ O	12.45	20.59	17.36	19.51
Na ₂ O	—	6.04	0.25	2.15

Leucite occurs very plentifully in the superpotassic lavas of the volcanic districts of Central and Southern Italy forming an important constituent and sometimes almost the sole component, of the leucitic rocks (Leucitites). These lithological types have been studied by a number of well-known scientists. Special mention is due to the work of WASHINGTON and SABATINI (see Bibliography in the two volumes: Vulcano Laziale, 1900, and Vulcani Cimini, 1912).

A rapid review of the percentage of potash present in the leucitic lavas of the volcanic districts of Italy might now be given. The figures are taken from my account published in 1901 and from the latter but more complete work of MODERNI (1914), to which those wishing for further geological, lithological and bibliographical information are referred (Fig. 43).

The K₂O data from the numerous analyses are given only when the potash content is above 6 %. (see Table, page 311).

Attempts have been made to extract leucite from the lavas of Borghetto, near the railway-station of Civitacastellana, in the neighbourhood of Orte and of Sessa Aurunca (Roccamonfina).

This work was however first started near the Capanelli of Rome, and below the mouth of the Frascati Tunnel, on account of the pyroclastic character of the lava in these localities. The lava contains many loose, vitreous, or almost transparent, crystals of leucite which make up from 20-30 % of its volume. Thus, the sifted material prepared for the magnetic separator included the following percentages of different particles: scoriaceous lava 56; leucite 37; augite 5.5; iron oxide, magnetite 1; biotite 0.5. This particular pyroclastic formation is found on the left side of the flow of leucitic lava which is crossed by the Via Appia Antica; its origin is probably due to a phenomenon similar to the so-called "*nube ardente*" described by

LACROIX (1908). The mechanical means hitherto employed were the hydraulic and electromagnetic processes, the highest condensation being obtain by the latter method. The loose leucite crystals in this deposit make it a very valuable source of raw material for agriculture, or industry ; but in order to work it economically some use must be found for the residue. This residue after sifting (normal sand 90.06 %)

(1:12500.000)

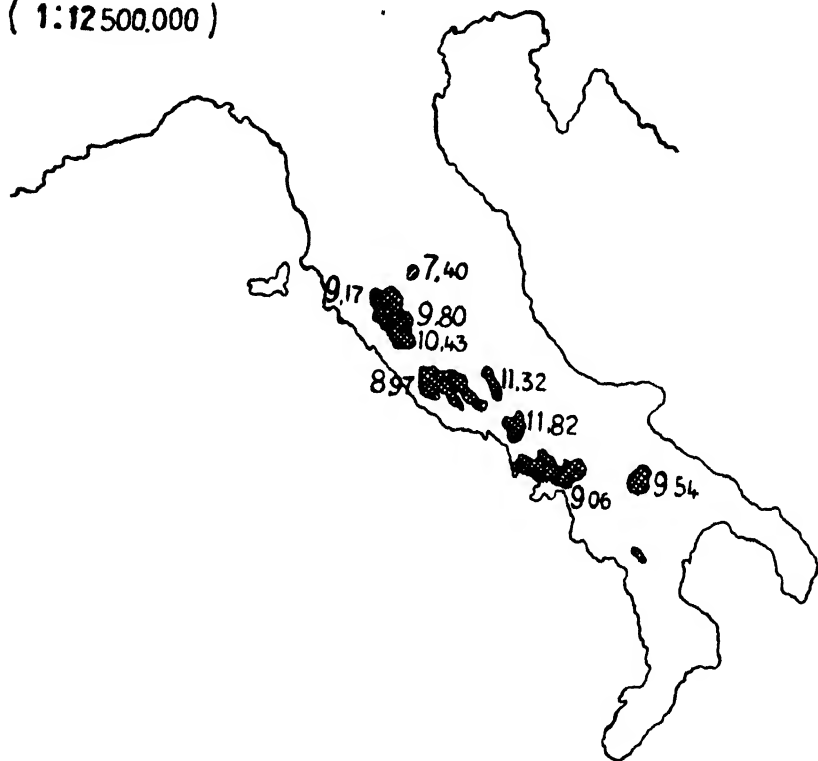


FIG 43 — The distribution of leucitic rocks in Italy
The numbers indicate the maximum quantities of potash (K_2O) per km

has good hydraulic properties and quickly combines with lime ; it is thus particularly well-suited for the manufacture of mortar, sand-cements and special kinds of reinforced concrete. The following data was obtained personally, at the works of the " Società Leucite " at Tor di Mezza Via di Albano.

Normal deposit (D. M. 10-1-1907) A. T. O. 1502, firm consistency at 5 mm. from the bottom. Ago Vicat 300 gm. first taken after

9 hrs, then after 48 hrs. Contraction 5 cm.; penetration 25 mm., traces of soluble silica; no zeolites.

Resistance test. Traction of Fröhling-Michaelis double-lever apparatus 1 cm.²; 5.386 kg.

Pressure resistance tests per cm.²: 31.880 kg. after being left to set for 49 days.

The lava material is at present only worked at Sessa Aurunca by the "Società Italiana Potassa" (the Borghetto factory is for the moment unoccupied). The above Society has kindly given me the following valuable information viz. Daily output 30 tons, soon to be increased to 60 tons; the factory is capable of again doubling its output. The material is now sent to France and to Cengio (Genoa), to be worked up into various industrial products which consist of chloride and sulphate of potassium, chloride of aluminium and powdered silica. The maximum and minimum data of four analyses of the granular material separated by the electro-magnets are as follows:

Moisture at 110° C	0.06	-	0.17 %
Fe ₂ O ₃	0.94		1.22
Al ₂ O ₃	20.50	-	22.19 "
K ₂ O	17.77		19.55 "
Residue insoluble in H Cl.	57.09	-	59.69 "

In order for this material from the lava to be suitable for a fertiliser, it is necessary to remove any iron which may be present in a ferrous condition, since it may unduly increase the adsorbent capacity of the soil and greatly decrease the concentration of the percolating solutions, thus diminishing fertility to some extent. This trouble may however, easily return.

The output of and the demands for this fertiliser are fluctuating and limited. Although this new industry will certainly not lack deposits in excellent working order, both in the pyroclastic rocks and lavas of Italy, it will not develop, or prosper, except under certain conditions, viz: The manufacturers of this fertiliser must regard the industry as providing an important problem to be solved, and not as a matter of business to be turned to profitable account more or less immediately. Technicians, or better, specialised factories, should manage, as the S. I. P. states it has succeeded in doing, to increase the K₂O percentage above 16 % by means of mechanical separation.

Italian agriculturists must become persuaded of the necessity for potassic fertilisers (where the soils are not volcanic) and the agri-

cultural journals of Italy will have to abstain from their foolish and short-sighted policy of puffing the various products, which results in every kind being used less. The prevailing ignorance of soil science, which is not confined to agriculturists alone, will still hinder the general realisation of the necessity and value of potassic fertilisers. When all are convinced of these facts, there will still remain the choice of the most effective, suitable and economical potassic fertiliser to employ. To the many persons who contend that agricultural soils, and more especially clay types, need no such fertilisers, I will reply in the very words of LAGATA himself "there is no connection between the quality of heavy soils and their potash content, that these soils should be rich in potash is merely a coincidence, although a probable one. Hence, it is a mistake to say that all heavy soils contain a high percentage of potash . . ."

Leucite when reduced to a fine powder is a potassic fertiliser which is becoming increasingly important for students of agricultural science in consequence of the many positive experimental results that have been obtained with it in connection both with plant and tree growth. The experiments were however not always properly carried out, or sufficiently repeated, hence they do not afford the positive evidence needed for the basis of a new fertiliser industry. Potash-loving plants in general, and leguminosae in particular, have shown the greatest susceptibility to leucite, but trees, also, where trials have been made, have shown directly or indirectly the advantage derived in one year from its application. The "Società Agronomica Italiana", with the co-operation of some of the most expert Italian research workers, has started a very promising series (See 1923 Report) of co-ordinated experiments throughout Italy and on a great variety of crops. It is to be hoped that the experiments will be repeated for a sufficient number of years to allow a positive opinion to be formed of the qualitative and quantitative value of leucite as a fertiliser. In the meantime, it will be highly useful to ascertain by every possible means the rules governing the practical and economic employment of leucite fertilisers for various soils and different crops.

As regards the susceptibility of soils to potassic fertilisers, the data obtained by SCHLOESING and tested by GAROLA are already available. They show that a soil is in need of the addition of potash when it contains 0.3 % or less of K_2O soluble in nitric acid of a strength of 0.013 %. DYER used citric acid and GRANDEAU hydrochloric acid.

This test is not however absolute, for many soils considerably richer in potash are much benefited by the addition of potassic fertilisers. The need of such fertilisers depends upon the complex movements of potash in agricultural soils which vary according to different circumstances, such as the lithological character of the soil, the other fertilisers used at the same time as the potash, and the specific crop grown.

Sodium salts (the chloride and nitrate) and ammoniacal salts (phosphates) are the most active in rendering potash soluble; next in order come the calcium salts (the chloride, carbonate and phosphate) and particularly gypsum and monocalcic phosphate. Other agents which assist the availability of potash are also present in the soil, as has already been remarked; hence it can be stated *a priori* that leucite will have the greatest effect when it is reduced to the finest powder and remains in the soil layers where the complicated processes of transformation are most active, and the roots, that can at once turn to account this vital element, are to be found.

It can be assumed as a general rule that all soils not directly derived from granitic, trachytic, or leucitic rocks, either in their original, or pyroclastic condition, are in need of potassic fertilisers.

Leucite can be spread at any time, but is better applied during the working of the soil, it may be mixed and used with any other fertilisers, and in the case of soils of the most varied lithological character and different physical constitution. It is advisable to apply leucite before spreading stable-manure, both fertilisers should be subsequently dug in together in order to secure the advantages resulting from the transformations taking place in the organic product.

The effect of leucite, like that of any other potassic fertiliser, must be judged by the symmetrical growth of the plants, and by the quality and quantity of their fruits and seeds.

Leucite forms the raw material for other chemical industries (including certain fertilisers), but these are not here considered. They have more or less directly to do with the manufacture of alum, potassium chloride and sulphate, aluminium chloride and sulphate, potassium nitrate, potassium-phosphate, alumina (aluminium), soluble silica, hydraulic cement, etc. Many patents have been taken out, but very few are practically used in industry.

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THE EUROPEAN SEED TESTING ASSOCIATION

Fifty-four years have now passed since the first seed testing station was founded in Tharandt, Saxony by the late Counciller, Dr. F. NOBBE. This first station no longer exists but 150 other stations are scattered throughout the world and of these 100 are to be found in Europe.

In the interests of international seed trade it has become a matter of greatest importance to standardise methods of analysis in use at these seed testing stations in such a way that the investigations made on corresponding seed samples may be comparable within reasonable limits. However, as in the case of certain seed species these investigations present great difficulties and require a well-trained and experienced staff of workers, the results from different stations are found to vary greatly.

In 1906 and 1910, as the result of German initiative, congresses were convened and the matter discussed. However, these congresses were not quite international, for with the exception of the leaders of several German stations the leaders of but few European stations were present.

In 1920 the present writer, who is the Director of the oldest seed testing station in the world, was requested by Sir LAWRENCE WEAVER, Director General of the British Ministry of Agriculture, to take the necessary steps in order that Denmark should issue official invitations for an International Seed Testing Conference to be held at Copenhagen in 1921. Hence, the Danish Foreign Office, in January 1921 sent invitations through the Foreign Offices of the countries in the following list, requesting them to send delegates to an International Seed Testing Conference to be held at Copenhagen, June 6-11, 1921.

The following countries signified their intention of sending delegates, all of whom, with but few exceptions, were present :

Argentina (1 delegate) ; Belgium (1) ; Canada (1) ; Denmark (2) ; Finland (2) ; France (1) ; Germany (2) , Great Britain and Ireland

(5) ; Holland (1) ; Hungary (1) ; Norway (2) ; Poland (1) ; Roumania (1) ; Servia-Slovenia-Croatia (1) ; Sweden (4) ; Switzerland (1) ; Tchechoslovakia (2).

At the opening meeting the Danish delegates, Professor Dr. W. JOHANNSEN and the present writer, K. DORPH-PETERSEN, Director of the Danish State Seed Testing Station, were respectively elected President and Vice-President of the Conference.

The following was the programme of the Conference .

1) Professor W. JOHANNSEN and Director K. DORPH-PETERSEN . Notices about the Conference. Paper on the Danish State Seed Testing Station. (The Conference paid an official visit to this Station).

2) Director F. F. BRUIJNING, Wageningen " General views concerning the international unification of methods of testing seeds in the interest of trade, more especially with regard to purity ".

3) Dr. VOLKART, Zurich "The determination of the origin of agricultural seeds ".

4) C. B. SAUNDERS, Director of the Official Seed Testing Station, London " Seed testing in the United Kingdom ".

5) Dr. BROWN, Washington " Seed testing in the United States of America " (read by Mrs. KØLPIN RAVN).

6) GEO. H. CLARK, Canada " Seed testing and seed control in Canada ".

7) Director K. DORPH-PETERSEN, Copenhagen " Notes on investigations in the control fields, as to purity of strain and freedom from disease in seeds ".

8) Professor Dr. A. VOIGT, Hamburg " Methods of germinating tests ".

9) Director WIDEN, Orebro " The testing of cereals ".

10) Ing. KOMERS, Vienna " The testing and valuation of beet seeds " (read by Professor VOIGT)

11) Dr. VITEK, Prague " The testing of dodder seeds ".

12) Dr. v. DEGEN, Budapest " Remarks on dodder seeds ".

13) Director L. BUSSARD, Paris " Measures taken in France to exterminate dodder plants ".

14) Professor SCHRIBAUX, Paris and Dr. v. DEGEN, Budapest : " Proposal concerning the methods for determining the limits of error in seed testing and for collection of material ".

Prior to the convening of the conference the present writer had caused series of seed samples of 25 species, to be sent to 25 stations,

with a request that they should be analysed. Results were returned from 24 stations and in order to form a basis for discussion, printed summaries of these results were distributed at the meeting. All the delegates present agreed that the summaries and the names of the seed testing stations in question should be published in the report of the conference.

On the last day of the conference a resolution proposed by Sir LAWRENCE WEAVER that a European Seed Testing Association should be formed was carried unanimously. A committee of the following members, Dr. VOLKART, Director of the Seed Testing Station in Oerlikon-Zürich, Dr. F. F. BRUIJNING, Director of the Seed Testing Station in Wageningen, and K. DORPH-PETERSEN, Director of the State Seed Testing Station in Copenhagen, was appointed to direct the work of the Association. Unfortunately Dr BRUIJNING died very shortly after, hence at a meeting held in Prague in September 1922, the remaining members constituted themselves a committee with K. DORPH-PETERSEN as chairman and Dr. VOLKART as secretary. At this meeting, plans for the work of the association, drafts of communications to be sent to the seed testing stations of the various European countries, and the manuscript Report of the International Conference in Copenhagen were discussed. This report (*) which, consists of 135 pages, contains the papers read and the discussions held in the languages used by the speaker (English, German or French). The more important questions discussed and all the resolutions passed are quoted in two principal languages. The report may be obtained on application to Dr VOLKART, Zurich, or K. DORPH-PETERSEN, Copenhagen on the payment of 5 Swiss francs or 5 Danish crowns.

On the last day of the conference it was decided to accept the invitation of the British delegates to hold the next conference in London and Cambridge in the early part of July 1924.

In March, 1922 new series of samples of 25 seed species were distributed to the European seed testing stations affiliated to the Association and to four American stations. Up to the present results have been returned from 41 stations and a summary of the whole will in due course be sent to all seed testing stations with which the writer is in communication. The committee carries on a regular cor-

(*) « Compte Rendu du Congrès International d'Essais de Semences »

respondence with many of the stations which are affiliated to the Association.

At present it is known that official seed testing stations exist in the countries mentioned below. The number of stations is stated in parenthesis for each country. Australia and New Zealand (3), Argentina (1); Belgium (1); Brazil (1); Canada (3); Denmark (1); Finland (1), France (1); Germany (27); Great Britain and Ireland (4), Holland (1); Hungary (1), Italy (2), Japan (1); Norway (3); Poland (14); Roumania (1); Servia-Slovenia-Croatia (2), Spain (2); Sweden (17); Switzerland (2), Tchechoslovakia (3); U. S. America (27) (*).

It was decided by the conference to submit the question of origin to a thorough examination and Dr. VOLKART who introduced the subject was unanimously elected to direct the work, the heads of the various stations promising to give him all the assistance in their power.

In order to investigate the question of dodder (*Cuscuta* spp.) a committee was appointed consisting of Dr. v. DEGEN, Budapest, M. VITEK, Prague, Professor BUSSARD, Paris, Professor VOIGT, Hamburg, and Mr. ENESCO, Bucharest. Several other questions brought up by the conference were referred to the Association (1).

GEO. H. CLARK, President of the Association of North American Seed Testing Stations, reported that the association was greatly interested in the co-operation and eventual union with the European Association. As chairman of the latter, the present writer is in constant correspondence with CLARK as well as with other leading men from the American seed testing stations (BROWN, Washington; MUNN, New York; STONE, Madison and others) and summaries of the results of comparative investigations from America and Europe have been exchanged. Even though the results received from many of the European stations vary greatly, those from the American stations vary even more. As many of these have only very recently been founded, the statistics are extremely difficult to compile.

Up to date the expenses of the committee have been largely covered by funds appropriated for the conference in Copenhagen

(*) Where there are in a country many seed testing stations, they are mostly combined with chemical laboratories

(1) In connection with the conference, excursions were made to the State Experiment Stations in Lyngby and Tystofte and to seed production and plant breeding stations.

by the Danish Ministry of Agriculture. However, this will only be continued until the conference meets in London, at which the question whether or not the work of the Association can be continued, will be discussed. If the decision is in the affirmative the countries which desire to be represented must contribute annually a sum, the amount of which depends on the number of votes in the Association desired by the country in question and the importance of seed culture, seed trade and seed testing in that country.

The report of the conference in Copenhagen is now published as Vol. 1 of a *Journal of Seed Testing*. The question of the publication of such a journal, will be laid before the conference. As the literature on seed testing is now scattered over a very large number of journals throughout the world, a journal of this nature seems to meet a real need.

The Directors of the seed testing stations who have become members of the Association show much interest in the work. It is sincerely to be hoped that this movement will tend to develop this interest and a more close co-operation between the seed testing stations in Europe and later in the whole world, thus bringing about more uniformity in results which in turn will benefit the ever-increasing international trade in seeds for field, garden and forest.

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THE CULTIVATION OF CORK-OAKS AND PRODUCTION OF CORK IN SPAIN

HABITAT OF THE CORK-OAK (*Quercus suber*). — There are three principal forests of cork-oaks in Spain ; these are situated in Andalusia, Estremadura and Catalonia respectively. The first covers the entire Mediterranean zone of the Provinces of Malaga and Cadiz extending into the Provinces of Seville and Huelva. The Estremadura forest joins the Portuguese woods of cork-oaks. The Catalonia forest is situated in the Provinces of Gerona and Barcelona.

The Andalusian forests of cork-oaks are chiefly to be found covering the vast uninterrupted area beginning at Serrama de Ronda and terminating on the Spanish coast of the Straits of Gibraltar. The tree grows up to an altitude of 1000 m. in the La Saucedá forest, on the outskirts of Cortes and of La Nava and on the borders of Ronda where *Quercus suber* nearly joins *Abies pinsapo* Boiss. which covers the greater part of the Sierra de la Nieve in that municipality.

As the cork-oak is a very exacting tree, it only attains vigorous growth and full development in deep, loose soil, although it will grow in shallow stony soil ; it should be noted that the cork produced on poor ground is of the best quality.

In the Andalusian region, the forest does not consist only of cork-oaks ; as a rule, these trees are there associated with the dyers' oak (*Quercus lusitanica*), the ilex (*Quercus Ilex*) and the cluster pine (*Pinus Pinaster*).

MANAGEMENT AND UTILISATION. — As *Quercus suber* is grown chiefly for cork, the tree must be treated in such a manner as to obtain the largest and best yield of that product. This entails the oaks being left in the wood until vegetative degeneration prevents any further cork-formation, therefore they are grown till they become tall trees. Since, however, this system of cultivation usually implies collecting the acorns from every tree and raising the oaks from seed, it should be understood that other cultural methods can also be adopted. Thus, in making these woods, stems cut from young trees

or seedling plants, can be used, for by this means long-lived trees attaining a large size and producing much cork can be obtained. Further, whenever a forest-fire destroys the aerial parts of a young stand, the damaged portions must at once be cut away, in order to obtain fresh shoots from the base of the trunks, for in this way, several advantages are obtained, viz., new trees within a short space of time, the continuity of the stand, the covering of the ground, which maintains the chemico-forestry equilibrium, and the formation of seed-plants with a large supply of acorns, which serve as a basis for the natural formation of new stands. This method is especially to be recommended when the advanced age of the trunks would have made their production doubtful.

As soon as acorns fall upon suitable soil they at once begin to germinate, the radicle being the part of the embryo that first develops, in order to provide nutritive substances for the maintenance of the seedling. The cotyledons remain intact and full of food reserves that will be drawn upon as soon as the root, which is already strong, has attained the length of about 10 cm., and the delicate plumule is just visible above the ground. As long as the seedling remains in this condition, the aerial part which is weak and almost herbaceous, is very liable to be destroyed by grazing animals, strong insolation, or other accidents due to its position. From one, or another cause, the seedling usually loses its aerial portion which is re-formed in the following autumn and is much more vigorous than the part it lost.

If when the tree is some years old, the tip is damaged by animals, or has its development arrested in any way, the trunk does not grow in the vertical direction, but remains stunted, becomes much branched and is incapable of producing cork, until such time as the injured part is restored, when the trunk begins growing but still retains its irregular shape, especially at the base, thus never entirely recovering from the effects of the injury.

If the ground is ploughed, these trunks form shoots that are strong and vigorous enough to insure the life of the tree, provided it is a sapling and not an adult specimen, as ploughing does not injure the root of system a sapling and the new shoots provide a more liberal supply of nutrition than could be furnished by the old, stunted, weakly branches in which the sap was unable to circulate sufficiently to maintain the balanced development of the epigeal and hypogean parts of the plant. It is necessary to remove the more weakly trees and thus prevent a severe struggle for existence, while the individuals

that remain must be carefully trained in order that they may form the basis of a stand capable of producing a large yield of cork. The cork-oak grows in a low thicket of dense shrubs and must be helped and protected till its size enables it to dominate over its low-growing neighbours. At this period of growth, assistance may be given by ploughing up the surrounding soil and destroying the under growth, and by thinning out the cork-oak for the first time. There is no objection to the number of trees left being sufficient to shade the ground with their interlacing foliage, since this encourages the saplings to grow tall and the soil is fertilised by the organic detritus that collects beneath the trees. The trees must not, however, be too thick, or the trunks will become crooked in their attempts to reach the light.

If the thinning and cleaning operations are carefully carried out their effects ought to last at least five years, and should the undergrowth form again, it will be less dense and can be removed the next time with less trouble and cost. In some places it is necessary to thin out the saplings early owing to their excessive development, but usually nothing is done till the undergrowth is out away and then the worst-shaped and weakest oaks are removed, thus making the stand thinner, but not to an extent that would interfere with the trees developing in height. Since thinning out has to be done periodically, it might be economical only to free from the brushwood those trees that are definitely intended to remain, but in point of fact, it is better to carry out this cultural operation in the case of all trees of sufficient size, even if it costs more because however carefully the work is done, lesions of the phloem layer are of frequent occurrence owing to the great difficulty in calculating the exact amount of force exerted by the blow of a hatchet upon a layer of very variable thickness and of unequal resistance. The injured trees must be removed when the wood is next thinned, this operation being carried out so as to leave enough trees to be stripped at the right intervals, and of a size to produce an adequate supply of cork.

The development of the stand will show when another thinning out is necessary; this operation is repeated at intervals until the oaks which are already bearing cork, become dense enough to furnish the largest amount of this product, when cleaning and pruning become essential. If the seedling oaks are not interfered with during the first years of their lives, they should be treated as described above. Should they, however, have suffered from the depredations of animals, or have had their normal development arrested in any way, it is advisable

to plough up the ground in order to obtain quickly, strong well-shaped trunks.

Allusion has been made to cleaning and pruning, but before going more deeply into the subject of the treatment of cork-oaks, it is necessary to define these two terms as they are understood in Spain. "Poda", or pruning, means the removal of one, or more, of the branches. In some places this operation is known by different names according to its severity. If there are three grades, very severe, severe and slight, the first is usually termed "tala" (cutting) the second "poda" (pruning) and the third "limpia" (cleaning), although it is impossible to define exactly the limits of each, which naturally may vary from one wood to another, and even in the same wood, owing to the exposure, altitude, etc. A cleaning on ground at a low altitude and with a southern exposure, where the soil is deep and rich, becomes pruning if carried out with the same intensity on high mountain peaks where there is little depth of soil and tree-growth is relatively limited, while where the conditions are reversed, the converse is the case. An examination of a cork-oak of normal density, will show that the shape of the tree is due to branching resulting from successive bifurcations. This is the natural type of branching, and to restore it is the object to be aimed at whenever, as a consequence of pruning, the snapping off of a branch, or any local accident, a stimulus is given to the activity of rapidly-developing adventitious buds which may disturb the vegetative equilibrium, even to a slight extent. If the injury is quickly remedied, normal conditions are soon restored, so that the light is able to play its important part in the formation of cork, but if some time is allowed to elapse, this result can only be attained by careful pruning carried out with due regard to the physical effect produced upon the tree.

It is necessary to replace old, badly-used cork-oaks that have been the victims of injurious and unscientific treatment, or of interference ever since the goats browsed on their first shoots, and have suffered from excessive pruning, late freeing from the undergrowth and partial, intense, and careless removal of the cortex.

It must not be forgotten that only a certain amount of completely ripe cork of the right thickness for industrial purposes can be obtained from any given tree, and that the cork-oak each time its cork is removed and the phloem is exposed to the air suffers a shock varying in severity according to the extent of the denuded area. If through greed, this is constantly increased until the cork is even re-

moved from the topmost boughs, which are always much branched in this species and there is great risk of not obtaining the desired amount of cork and of seriously imperilling the life of the tree, since it is thus obliged to produce annually a very extensive cork-layer and to reconstruct the various organs upon which its existence depends.

In such a case the cortex formed every year cannot be of sufficient thickness, for unless each tree is stripped of its cork in regular turn, the suberous layer is not of the depth required by the industry, and the new organs are not formed as completely as is necessary for them adequately to perform their functions. In such a case, skilful and well-directed pruning may save a perishing tree.

At least three years must be allowed to intervene between pruning and the removal of the cork. The narrow ring of living tissue exposed by pruning begins to produce a layer of cork externally which corresponds with the internal layers of phloem and wood, thus making a kind of pad that cicatrises the wound and causes it to disappear altogether, if it is not extensive and if the tree is sufficiently vigorous. If however, the suberous layer surrounding the wound is removed before the phloem is equal to bearing the strain, it is stripped off together with the cork, thus exposing the wood and producing a fresh wound which often never heals, or only does so with difficulty. In order that pruning may be beneficial, it must not be excessive, or be performed at an unsuitable period.

Thus, care must be taken not to disturb the equilibrium of the tree's vegetative conditions, for it must be borne in mind that the leaves discharge important vital functions, since they are the organs of respiration and of chlorophyll assimilation. The surface of the cut should as far as possible be vertical and smooth, so as to form no resting place for the spores of cryptogams. In many of the cork-oak woods in charge of the author, the cuts are protected with a layer of tar and the results obtained have been thoroughly satisfactory.

ROTATION. GENERAL ROTATION. — The cork-oak is stripped when physically mature, which means keeping the tree as long as it has sufficient vitality to produce cork that satisfies the requirements of the industry. When the trunk decays and can no longer support the weight of the crown, and the dead branches of the summit indicate the decay of the tree, the annual cork layers become very thin. The tree is then felled for the benefit of the plantation; the wood is of average quality.

The age at which the cork-tree reaches this condition cannot be



PLATE XIII



FIG 40 — Forest of EL ROHIDAI
Barking of branches



FIG 41 Forest of EL ROHIDAI
Reafforestation

fixed with any certainty. Some treatises give 120-150 years as the cork-bearing period which, added to the period before the suberous layer is formed, would make 120-200 years. This computation is only a rough estimate for the guidance of the general reader, as the age at which the above-given set of symptoms show themselves varies according to the individual, the treatment it has received, and various accidental external circumstances. Therefore no fixed rotation for cutting down cork-trees can be given. The tree is felled when it can no longer produce cork, and its removal is advantageous to the growth of the surrounding saplings. If this plan is adopted in the case of cork-woods of the same age and the result of artificial planting, the individuals in the same plantation are of different ages since there is no fixed time for felling, and thinning out is a matter of individual choice, also sometimes it will be necessary to remove one of the largest trees in order that its place may be filled by another tree of superior vigour, or capable of producing cork of finer quality.

ROTATION OF BARK-STRIPPING. — In accordance with economic rules, the cork is not removed until it has attained the degree of maturity and thickness required by the industry. The commercial rotation is therefore adopted, and the time is fixed with a view to fulfilling the above conditions. Owing to the many ways in which cork is used, the thickness of the product required is very variable but generally, when the state of the market is normal, the demand is regulated by the necessities of bottle-cork manufacture, this being the most important branch of the industry and the one deciding the cork-stripping rotation. From this point of view, it may be said that the cork can be cut when it is 27 to 32 mm. thick, and the first stripping is carried out as soon it has reached this depth. The thickness of the layers formed annually differs considerably from one wood to another, as well as in various parts of the same plantation, or even of the same tree. There is also a great variation in the soil conditions, exposure and altitude etc., necessary for the cork-oak to grow and thrive. The cork-layer increases most in thickness at the base of the trunk, gradually becoming thinner towards the extremities of the highest branches. In a transverse section of cork, it is seen that the oldest layers are the thickest, while more recent layers gradually become thinner, till the effect of the last additions is practically negligible in increasing the total thickness.

When a tree has just been stripped, the first layer grows freely, but the second encounters a certain amount of resistance from the

first layer and the third suffers from the pressure of the two external layers ; this pressure increases with the further growth of the cork. Therefore the suberous cells are not arranged in annual rings, as they would be if each layer were independent of the influence of the others. Cork that has been stripped from the tree and is then put for some time in boiling water, liberates substances soluble at boiling point, and its cells assume shapes and positions that increase its elasticity, which is an indispensable quality in the case of some branches of the cork industry.

Although cork often reaches the required thickness in 6 years, it should not be cut until perfectly mature, but must be left for another three years to ripen completely even if, in the interval, its thickness may become somewhat reduced. In the cork-woods of Andalusia and Estremadura, the cork is collected every 9 to 12 years. In Catalonia, the intervals are much longer.

SYSTEMATIC CORK COLLECTINGS. — From what has been said in the preceding paragraphs, it would appear that in order to obtain cork of the type in demand on the market, it would be necessary owing to the variable development of the product, to take selected pieces from each tree, or at least to cut it from isolated, specially suitable individuals. Fortunately however, the many different thicknesses of cork required by the industry make it possible, at all events in the case of extensive woods, to strip the trees growing on a large area although to insure a regular annual return, the plantations are divided into plots to be stripped in turn, so that there is no loss from the cork being insufficiently thick or immature, or from its having become too thick. In the latter case, most of the crop consists of waste material and the inner layers which could have ripened latter remain unused.

ARTIFICIAL REAFFORESTATION. — In replanting the cork-woods in my charge I have had recourse to artificial reafforestation so as to supplement the efforts of nature where the trees have been cut down, thinned, or are of too sparse growth. Reafforestation can be effected either by sowing or planting. Sowing is more suited to land that has been, or can be, ploughed at small expense ; the acorns may be sown in any of the ways described in treatises on sylviculture, although it is best to plant them in little groups, or in the furrows made by the plough.

In the first case, the seed-bed is ploughed and 3 or 4 acorns are planted at a time and then covered with a layer of fresh soil not exceed-

ing 2 cm. in depth, and some large stones are placed round the spot. The ploughing is done over the whole surface, or in strips ; if the former method is adopted the acorns are sown broadcast, otherwise they are dropped one at a time into the furrow. Sometimes good results are obtained by mixing acorns and seed-corn. The cereal crop compensates for the labour entailed and costs but little.

Since acorns soon lose their germinating power, they should be planted (according to the natural date of maturation and dissemination) not later than December or January. The acorns ripening in the second half of November should be chosen by preference.

If young trees are to be planted, a plot with a gentle slope should be chosen in the nursery and divided by little trenches 15 cm. deep running in the direction of the slope. In this plot the acorns are sown and are covered with a thin layer of soil. About 2 months later, at the height of the germinating season, the seedlings are lifted, the radicle of each is cut off below the point of insertion in the acorn, and the seedlings are taken up, great care being expended to avoid injuring the mass of rootlets formed as a result of the removal of the radicle at the time they were transplanted, and the young trees are planted out finally in holes proportionate to their size.

The author has tried another system with conspicuous success ; this consists in sowing the acorns in a nursery as in the above case, and leaving the seedling till the funicle begins to appear above the thin layer of soil covering the acorn which is still in a state of perfect preservation. The seedling which is then composed of the developing funicle, the intact acorn and the radicle, can be transferred and planted without injury in the area to be reafforested.

The acorn contains an abundant supply of nutritive substances which suffices to tide the seedling over the transplanting crisis and support it until it is able to provide for itself. From this it is seen that the chief requisites for success in planting are to lift the seedlings at the right time, and to avoid planting out any seedling that is not provided with a perfectly healthy acorn.

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AGRICULTURAL INTELLIGENCE

AGRONOMY

SYNTHETIC ARTICLES.

159. The Absorption Power of Plants in relation to Soil Nutrients.

I. — BAUER, F C. and HAAS, A R C. (Agricultural Experiment Station, University of Wisconsin) The Effect of Lime, Leaching, Form of Phosphate and Nitrogen salt on Plant and Soil Acidity, and the Relation of these to the Feeding Power of the Plant *Soil Science*, Vol XIII, No 6, pp 461-480, figs. 8, bibliography Baltimore, M D, 1922

II — TRUOG, E (Agricultural Experiment Station, University of Wisconsin) The Feeding Power of Plants *Science*, Vol LVI, No 1446, pp 294-298 bibliography Garrison, N. Y., 1922

III — ARRHENIUS, O (University of California, Soils and Bacteriology Laboratory) The Potential Acidity of Soils *Soil Science*, Vol. XIV, No 3, pp. 223-232 bibliography Baltimore, M D, 1922

IV — ATKINS, W R G (Formerly Indigo Botanist to Government of India) The Hydrogen-ion Concentrations of some Indian Soils and Plant Juices *Agricultural Research Institute, Pusa, Bulletin* No 136, pp 12, bibliography Calcutta, 1922

I-IV — Different species of plants vary greatly in their power to absorb minerals from the soil. For example buckwheat will feed much more freely on mineral phosphates than maize.

It was formerly believed that the mineral matter of soils was made soluble and available to plants through the action of various acids excreted by the roots. Attempts to explain differences in feeding power on the basis of differences in amount of carbon dioxide excreted have not been successful. Later experiments, especially those by CZAPEK indicated that normally only minute quantities of acids are excreted.

It might be considered that the excretion of acids in measurable amount is not necessary to exercise any influence on the solution of mineral matter; in fact it might be argued that all that is necessary is for the acids to saturate completely the walls of the root hairs which come in intimate contact with the mineral particles. That this hypothesis is incorrect has been demonstrated in the investigations in actual and potential acidity. The

influence of acidity in the soil upon growth of plants has long been recognised

Titration of the soil extract to find the total acid required to bring to the neutral point to some selected indicator was the former method employed. The measurement of the *hydrogen-ion* concentration is now considered to be of chief importance. For example, a decinormal solution of acetic acid will require as much alkali to neutralise it as will a decinormal solution of hydrochloric acid, yet the two have very unequal hydrogen-ion concentrations, for the latter is almost completely ionised, whereas the former is only slightly so.

The hydrogen-ion concentration may be measured very accurately by the potentiometer method. This is, however, decidedly complicated and consequently for practical purposes the colorimetric measurements are preferred; the latter permits of comparisons, by using certain selected indicators and standard solutions of known hydrogen-ion concentration. Satisfactory results have been obtained by adopting this method.

In recording hydrogen-ion concentrations, a normal solution contains 1 gm. ion of hydrogen per litre, expressed in small quantities, average pH value 10.

A considerable amount of work has been done in connection with plant distribution and soil reaction by WHERRY, HOAGLAND, etc. Complications are found *e. g.* the atmospheric oxidation and the consequent increase in acidity. According to the experiments made by TRUOG and MEACHAM, CLEVINGER, BRYAN, BAUER and HAAS and ATKINS, there is no correlation between the actual acidity in the plant juices and the feeding power of the plants. For example, sweet clover and lucerne with relatively slightly acid root saps of pH 6 to 7 feed more freely on feldspar than buckwheat, with a relatively strong acid root sap, pH 4 to 5. If plants render the mineral matter of soils available through the excretion of acids, the reverse should be true.

It is therefore necessary to find some other explanation for certain differences in feeding power. In 1915 TRUOG presented a theory in which the feeding power was explained on the basis of *mass action*. Further investigations on these lines were conducted by BAUER and HAAS and followed up by TRUOG and these indicate that the reaction making the natural mineral available to plants is incomplete, uniform, or reversible.

For example, the reaction making the phosphorus of rock phosphate available to plants is one between carbon dioxide and the tricalcium phosphate in rock phosphate which may be represented as follows:



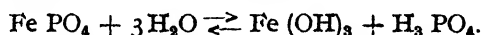
In order that this reaction may continue indefinitely, it is necessary that both products of the reaction be removed.

With plants like sweet clover and buckwheat, which absorb a large amount of calcium removed in the form of calcium bicarbonate, and rock phosphate, the solubility of the rock phosphate is increased and rendered immediately available. Plants with a low calcium content, such as oats or maize are unable to absorb the calcium bicarbonate; consequently the

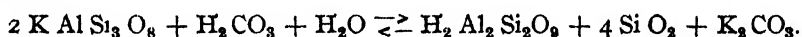
rate of solution of the phosphate becomes slower and the plant is unable to feed advantageously.

The theory may be tested as follows: the immediate availability of rock phosphate to plants such as maize is much greater on acid soils, due to the removal and precipitation of the calcium bicarbonate from solution by soil acids. The effect is the same as if the calcium bicarbonate were removed by the plant. This leaching removes the excess of soluble calcium bicarbonate and the effect is as though it were removed by the plant. BAUER has shown that the availability of rock phosphate in the case of maize (working with quartz cultures), may be increased by leaching.

Also indirectly, the addition of ammonium salts has also been found to increase the availability of rock phosphate. This is partly due to the effect of the salts in increasing the solubility of calcium bicarbonate. The reaction is more complex than the explanation given above, so far as relates to the formation of acid calcium phosphate and phosphoric acid, both of which are soluble and therefore introduce complications, but the case is quoted as an example only. On the other hand the reversible action is simplified. Hence ferric phosphate gives by hydrolysis ferric hydrate and phosphoric acid according to the formula.—



Only the last product is soluble, and which can be removed by the plant. A similar reaction occurs with aluminium phosphate and the solution of potassium from orthoclase feldspar by hydrolysis or carbonation.



The reactions in which only one soluble product is formed may continue without any hindrance, for as soon as the soluble product is removed by the plant, more is brought into solution. In such cases, the feeding power of the plants alone limits the reaction, this capacity of assimilation depends upon many factors that have been analysed by TRUOG.

Plants are able to precipitate from solution those elements which they require to constitute the essential parts of their organism. As one mineral is abstracted, another can be taken up by the root-hairs to be used subsequently. This explains why certain plants are better able than others to utilise some elements and can obtain them from very dilute solutions. Under other conditions, however, the absorption ceases.

The mineral elements absorbed by plants may be fixed by precipitation, or held in physical and chemical combination with important colloidal plant compounds or complexes. Potassium is used largely for the first purpose. The completeness with which an element may be precipitated out of solution depends on the reaction of the latter and on the solubility of the precipitate formed. As a rule, base-forming elements are more completely precipitated from a slightly acid, or neutral, solution (about 7 pH) than from a more acid solution. The sap of the leaves is of especial importance, for in these organs the most active vital processes take place. Plants with slightly acid or neutral leaf sap, should be able to utilise potassium

advantageously from a more dilute solution and feed more strongly on a slightly soluble potash mineral like feldspar, than those with a more acid cell sap, provided the reaction of the nutrient solution is favourable to the plants. Sweet clover is thus most active in utilising potassium, and BAUER found it possible to make normal growths, when forced to obtain all its potash from feldspar. The sap of sweet clover ranges from slightly acid to slightly alkaline as HAAS has shown. Of all the cases known to TRUOG this is the only one in which the sap is sometimes alkaline. On the other hand, buckwheat has very acid leaf sap which explains its poor utilisation of the potash in feldspar. TRUOG has found that lucerne and sweet clover can obtain potassium for normal growth from more dilute solutions than maize and buckwheat which have a more acid sap.

Undoubtedly the solubility of the potassium compounds formed in different plants is also a factor in their feeding power, but presumably these potassium compounds are to some extent similar and hence have somewhat similar solubilities.

Calcium, as well as potassium, is also used to render insoluble the colloidal plant compounds, but to a less extent. The chief effect of calcium is to neutralise and precipitate acids (*e g.* oxalic acid in the form of oxalates); thus it regulates the reaction of the plant sap. The relation of calcium to sap acidity appears to be the opposite of what has been established for potassium. The more acid the cell-sap, the easier can the plant obtain calcium from the soil. Buckwheat and sorrel are rich in calcium, as are also the cultivated legumes and many cruciferae.

In addition to the two above-mentioned purposes for which potassium and calcium are used by plants, there is yet a third, for they may also act as carriers of acid-forming elements. Magnesium is probably used as a carrier of phosphorus. It appears that the acidity of the cell-sap plays the same part in this connection as in the case of potassium utilisation.

There is no clear distinction between the three above-described purposes, one element such as calcium could effect them all. Certainly, other factors come into play, but it seems that the given factors explain to a considerable degree the physiology of the mineral exchanges taking place in plants and probably exercise a controlling influence upon them. They also throw light on many cultural practices such as the manuring and improvement of soil, and they provide the modern agriculturist with the means of attaining his object.

Experiments have hitherto been carried out on only a few plants, but the available data are very useful. The results obtained explain why buckwheat and lucerne, both plants with acid sap, need much calcium, while maize and oats, which produce little acid, have a low calcium content, and show the reason for the necessity of supplying cereals with soluble phosphates, although sweet clover can use phosphates and potash in a very slightly soluble form, etc.

Soil reaction must also be taken into account; this should as a rule be similar to that of the sap, although there are differences of behaviour in various plants.

The reaction of the sap of common agricultural plants has a range of

pH 4 to 8 which is practically the same as that of the soil solution. Too great or too little soil acidity is detrimental to plants, as it causes the precipitation of useful substances and the solution of injurious substances. Plants growing in solution cultures of unfavourable reaction tend to change this reaction to a more favourable one. This follows from the law of mass action, and the composition of the plants is somewhat altered. The chief modifications take place in the roots and the least in the upper portions of the plant, as BAUER and HAAS found in the case of maize grown in quartz sand and certain nutrient solutions. This adaptation can only occur within certain wide limits. Thus for instance, the acidity of lucerne is only pH 6, and the plant inevitably suffers if obliged to grow on a soil with a reaction of pH 5 (viz. in a medium ten times as acid, as its own sap, since the progression is logarithmic). It cannot obtain basic material from such an acid soil, therefore the plant grows slowly, becomes sickly in appearance and easily succumbs to adverse weather conditions or parasitic diseases. Buckwheat also needs much basic material; in fact, in its flowering stage, it has a higher calcium content than lucerne and yet it grows well on acid soils. This is due to the high acidity of its sap, viz. pH 4 to 5, which enables it to obtain calcium from a slightly less acid soil solution (pH 5). The amount and the solubility of the mineral content of the soil are thus not the only factors concerned, but the acidity of the plant and of the soil have also to be taken into account. If the plant needs much calcium, it does best on a soil which is a little less acid than its sap. The soil solution of acid soils often contains more calcium than that of less acid or neutral soils, and yet plants like lucerne suffer more from lack of calcium in the first case than in the second, because the acidity makes the calcium less available. Availability depends not solely on solubility, but also on the form in which an element exists in solution.

Plants are both capable of adapting themselves within certain limits to the reaction of the substratum, and also possess the power of slightly changing this reaction, although the process is almost always long and difficult owing to the buffer action of soils. This action which has been compared by FERNBACH and HUBERT to that of a pad, consists in checking or reducing the speed of the factors modifying acidity. The term has been accepted by SORENSEN (German "puffer", English "buffer", Italian "cuscinetto").

Buffer action is of great importance in pedology and according to ARRHENIUS has not received the attention it deserves.

The addition of the same amount of acids or alkalis to given quantities of various soils with the same hydrogen-ion concentration and acidity causes different changes in this acidity. In some soils, the change is slight, in others it is considerable. In the second case the soil is said to have the higher buffer action.

This behaviour is due to the neutralisation of the hydrogen radicle or to the non-ionised hydrosilicic radicles that can be replaced by basic or acid radicles. It reveals the inactive acidity or alkalinity and therefore is designated by ARRHENIUS, the *potential or actual acidity*.

The importance of strong buffer action in a soils is due to its lessening

the reactions that tend to take place, and maintaining unchanged the active acidity. It serves to prevent auto-intoxication on the part of plants. If the actual acidity of a soil lies within certain limits, the buffer action produces the best conditions for the absorption of the chief mineral elements, if it passes these limits, it becomes injurious by making correction more difficult. Generally, soil fertility is associated with buffer action, as ARRHENIUS discovered from the study of some American and West Indian soils. Buffer action curves might be usefully applied to determining the lime requirements of a soil, and would thus be of use in practical pedology.

The potential acidity of soils was measured as follows: A series of flasks was taken, into which were introduced 5 gm of soil and then 10, 5, 2, 1 cc of about 0.1. N. acid (or the same amounts of alkali) the solution was then made up to 20 cc with distilled water. The flasks were corked, shaken and left to settle. After filtering, the pH values were determined colorimetrically in the filtrate. The amount of acid or alkali added was calculated in cc of 0.1. N. solution per gram of dried soil at 100° C.

The buffer action of soil can be improved by humus-manuring and cultivation. L. V.

160. The Phosphate Crisis in Germany.

I. — AEREBØE FR. Stickstoffdüngung zu Stickstoffsammelnden Kulturpflanzen, *Zeitschrift für Pflanzenernährung und Düngung* (Wirtschaftlich-Praktischer Teil), Vol. I, No. 4, pp 145-152. Leipzig, Berlin, 1922.

II. — LEMMERMANN, O. Die Frage den Phosphorsäuredüngung. *Zeitschr. für Pflanzenernährung u. Düngung* (Wirtsch.-Prakt. Teil), Vol. I, No. 5, pp. 201-232, 1 pl. Leipzig, Berlin, 1922.

III. — HASELHOFF, E. Die Aufschliessung der Phosphorsäure durch Pflanzen und Düngemittel *Zeitschr. f. Pflanzenernährung u. Düngung* (Wirtsch.-Prakt. Teil) Vol. I, No. 6, pp. 257-282 Leipzig, Berlin, 1922.

IV. — MITSCHERLICH A. Über die Wirkung der Phosphorsäuredüngung. *Zeitschr. f. Pflanzenernährung u. Düngung* (Wirtsch.-Prakt. Teil), Vol. I, No. 6, pp. 282-295. Leipzig, Berlin, 1922. Neue Düngewirtschaft ohne Auslandsphosphate (*Zeitschr. f. Pflanzenernährung u. Düngung* (Wirtsch.-Prakt. Teil), Vol. I, No. 7, pp. 323-327. Leipzig, Berlin, 1922.

V — PFEIFFER TH. Die Verwendung der phosphorsäurehaltigen Düngemittel in der Landwirtschaft, *Zeitschrift für Pflanzenernährung u. Düngung* (Wirtschaft-Prakt. Teil), Vol I, No. 7, pp. 313-323. Leipzig, Berlin, 1922.

VI. — NOLTE, O Phosphorsäuredüngung einst und jetzt. *Zeitschr. f. Pflanzenernährung u. Düngung* (Wirtsch.-Prakt. Teil), Vol. I, No. 8, pp. 373-389. Leipzig, Berlin, 1922.

I. — As early as 1910 and 1911 Prof. AEREBØE (I) observed that a lucerne crop could be considerably increased by the substitution of a fertiliser containing nitrogen, phosphorus and potash for the usual phosphatic-potassic fertiliser. This fact forms the basis of AEREBØE's theory that a nitrogenous fertiliser should be applied to leguminosae in general, so as to enable them to utilise the soil phosphates and dispense

with any addition of a phosphatic fertiliser. (See the author's original article in this Review).

This question has been much discussed in Germany. Prof. NOLTE's (VI) views on the subject may be summarised as follows :

Until 1914, phosphates were used for the land in continually increasing quantities. In 1913, about 650 000 tons of phosphoric acid were employed for this purpose in Germany. In addition, forage was imported from abroad which provided a further supply of phosphoric acid that reached the soil in the form of dung. On an average, 10 % of the phosphoric acid thus restored to the land is utilised by the plants, therefore for many years more phosphoric acid has been given to the soil than has been removed by the crops. According to the statistics furnished from 1870-1912 (by the Vibransche Wirtschaft of Calvorde) 26 kg. more phosphoric acid per hectare was returned to the soil during that period than had been abstracted from it. This is not a unique instance.

In order to free Germany from the necessity of importing phosphates, AEREBOE proposed the utilisation by means of special methods of the phosphate reserves existing in the soil. This scheme is based on the following hypotheses.

From the point of view of phosphoric acid assimilation, plants may be divided into two classes, the one consisting of plants such as the graminaceae that use little, or no, phosphoric acid and the other made up of orders such as the leguminosae and cruciferae which are able to assimilate insoluble phosphoric acid with relative ease. The present practice of applying phosphatic fertilisers to the second group should be discontinued, as they are well able to obtain their own supplies from the reserve store in the soil. The application of a liberal dressing of nitrogen and potash is all that is needed to increase the growth of the crop, the forage production, and albumen content, and the phosphoric acid assimilation would also be raised. A larger forage crop would mean more dung and as the phosphoric acid present in the latter occurs in a form available for all plants, the use of phosphatic chemical fertilisers would be rendered quite superfluous. The utilisation of the soil phosphoric acid can be still further increased by the application of physiologically acid fertilisers and by giving no lime to gramineae. Since leguminosae live in symbiosis with the bacteria of their root nodules and are therefore able in the presence of a sufficient supply of mineral fertiliser to assimilate the nitrogen of the air, no nitrogenous fertilisers are now applied to them. A little nitrogen would, however, be very helpful in assisting the plants over the period before the bacteria have migrated from the soil to the roots, because until symbiosis is established, leguminosae like other plants are forced to use the nitrogenous compounds in the soil.

Opinions are much divided as to the expediency of supplying large amounts of nitrogenous fertilisers to leguminosae, for if this is done, the plants make exclusive use of combined nitrogen and it is a question whether this does not entail loss. Many German authors (one of whom is Kossowich, *Russ. Jour. f. exp. Landwirtschaft*, 1905, 6, 567) have found this method of manuring unsatisfactory, while several American Agri-

cultural Stations (*United States Dep. Bureau of Soils, Bull. 93*) as well as the Rothamsted Station (*Agric. Invest. at Rothamsted During a Period of 50 years, 1895, 97, 100, 103*) have not obtained good results from it. F. SCHÜLER was, however, eminently successful in his experiment of applying cyanamide to lucerne. Not all leguminosae have the same capacity for assimilation of insoluble phosphates, further, all phosphates are not equally available. PRIANISCHNIKOW found that certain mineral phosphates readily yield phosphoric acid, even to gramineae. The lupin appears to have a greater power of rendering phosphates soluble than is possessed by any other of the leguminosae, whereas owing to its being unable to assimilate the phosphates of the soil, crimson clover perishes if given a liberal dressing of a nitrogenous fertiliser containing no phosphate. (*Journ. f. exp. Landw.*, 1905, 6, 567). Some authors have observed that when a nitrogenous fertiliser is applied to beets, a larger amount of the soil phosphoric acid is absorbed, so that the cereals sown in the same field after the beets have been lifted suffer from a lack of available phosphoric acid.

It is well-known that the yield chiefly depends upon nutritive substances that are present in relatively very small quantities. Any addition of such substances increases the crop, but also augments the absolute amount of ash, probably because the fertiliser stimulates the development of the root system, so that larger quantities of mineral substances can be absorbed. AEREBØE is of opinion that the assimilation of the phosphoric acid is affected by the kind of fertiliser employed and that physiologically acid salts, like sulphate of ammonia, promote absorption, because the sulphuric acid liberated when the ammonia is assimilated by the plant would be able to dissolve the phosphate. Thus, the process taking place in the soil would be similar to that employed in the manufacture of superphosphates.

On the other hand, physiologically alkaline salts, like nitrate of sodium, from which the plants first abstract the nitric acid, would increase the alkaline action of the soil by means of the liberated sodium which, in its turn, would hinder the absorption of the phosphoric acid by the plant.

NOLTE however, does not hold this view, he bases his objection on the fact that the free sulphuric acid would in the first instance attack the lime in the soil and that the amount of sulphuric acid present is not sufficient to make the availability of the phosphates very probable. As regards the nitrate of sodium, it could be equally well asserted that the sodium possesses the power of dissolving certain phosphates, since the phosphates of aluminium and of iron are soluble in caustic soda. According to NOLTE, the solubility of the phosphoric acid is chiefly dependent on the solubility of the calcium salts (*Journ. f. Landw.*, 1917, 17) but there is no correlation between the solubility of the phosphoric acid and the acidity of the soil. (See also: C. CLAUSEN *Deutsche Landw. Presse*, 1922, 49, pp. 217 and 246).

E. RAMANN (*Deutsche Landw. Presse*, 1918, 45, 256) maintains that plants obtain most of their phosphoric acid directly from the phosphate

particles and only assimilate a small amount of the phosphoric acid in solution. If this were the case, there might be some truth in the theory that the phosphoric acid is rendered soluble by the sulphuric acid liberated after the absorption of ammonia, but the Rothamsted experiments show that larger crops of beets, barley and wheat are always obtained when nitrate of soda, instead of sulphate of ammonia, is applied as a fertiliser.

AEREBOE seems to misapprehend the function of lime. Cases have been known where the oat crop was reduced to less than half as a result of the application of sulphate of ammonia to a sandy soil poor in lime. (CLAUSEN, *Deutsche Landw. Presse* 1922, 49, 217). NOLTE and LEMMERMANN are of the opinion that the yield of crops manured exclusively with nitrogen and potash depends upon the nature of the soil phosphates which are generally more easily assimilated than the potash present in the soil. It must not however be forgotten that it may be very injurious to spread a potassic fertiliser on land with a large potash content, even if a similar amount of phosphate is also present. It is necessary to find out which soils received most superphosphates previous to the War. The phosphate question must not always be regarded from the point of view of the quantity of the yield, as the quality of the crop must also be taken into consideration. Potatoes and beets need a phosphatic fertiliser if they are to grow well, and the sugar content of beets is certainly increased by dressing the field with phosphates.

Prof. THEODOR PFEIFFER (V) treats of the problem from the economic standpoint. AEREBOE'S new theories are chiefly based upon the results of experiments carried out by Fräulein VON WRANGELL, who believes that the capacity possessed by leguminosae for utilising crude phosphates and the phosphoric acid of the soil is closely connected with the tolerance of these plants for lime. The molecular ratio $\text{Ca} : \text{P}_2\text{O}_5$ in the plant would appear to be a measure of its power of assimilating the above phosphatic compound. Cereals generally have a low $\text{CaO} : \text{P}_2\text{O}_5$ factor which is 1.3 in wheat and rye, 1.6 in barley and oats and 3 in maize. Next come potatoes leguminosae (beans, peas, vetches), with about 7, clovers with 12, forage and sugar beets and hemp with 23 and tobacco, rape, mustard and buckwheat with 17. This theory seems a very plausible one but it has not been verified. Even Fräulein VON WRANGELL herself found under special conditions that the factors for maize and mustard were respectively 16 and 7.

As regards AEREBOE'S suggestion that leguminosae should be given a dressing of nitrogen as well as of potash, two cases must be distinguished 1) when they are to be used as a green manure; 2) when they are to serve as forage. Where the question is one of growing leguminosae for green manure, AEREBOE'S method is ridiculous according to PFEIFFER. He justified his censure in the following manner: Assuming that an increase of 500 kg. of lupins (air-dried material) is obtained per morgen (about 2 ac.), that, roughly speaking, 50 % of the nitrogen in the fertiliser is used, and that the activity of the root-nodule bacteria is not hind-

ered, it still remains that 22.8 kg. of nitrogen costing 588 marks (1) would have been used. AEREBOE himself says that by the spring, there would remain but little (only some 15 %) of the nitrogen from the green manure dug in during the previous winter. If this be the case, and even if we assume the nitrogen of the green manure to be the same value as the nitrogen of the chemical fertilisers, the 2.06 kg. of nitrogen left will be worth 53 marks. In addition, the green manure will have removed from the soil 2.9 kg. of P_2O_5 , which, converted into fertilising material, represents an outlay of (588 — 53) 535 marks. Even if there were no loss of nitrogen, the phosphoric acid would cost 235 marks more, whereas the same amount of water-soluble phosphoric acid from chemical fertilisers would cost only 43 marks. In PFEIFFER's opinion, AEREBOE makes a mistake in saying that the chief work of lupins and serradella when used as a green manure is to assimilate atmospheric nitrogen and correct nutritive solutions. In reality, the rôle of these plants is to increase the quantity of phosphoric acid at the disposal of the next crop.

At the same time, PFEIFFER agrees with AEREBOE that leguminosae should not always be "nitrogen starved", though they can well do without nitrogenous fertilisers at the present time, not so much on account of the cost of the latter, but because they are very scarce in Germany. PFEIFFER wishes to put agriculturists on their guard against the use of green manures, for generally speaking, the direct application of the nitrogenous fertiliser is more profitable in the case of cereal crops. When on the other hand, the leguminosae are not used as green manure, but as forage, a nitrogenous fertiliser can be applied with much advantage. Thus for instance, an addition of 100 kg. of clover hay contains after the albumin has been subtracted, 28.6 kg. of starch which produces about 7 kg. of fat in the animal organism. Naturally, the character of the soil and its nitrogen content must always be taken into account.

AEREBOE advises pastures being dressed with larger quantities of nitrogen and potash, but with no phosphoric acid. This might be successful where there were still large reserves of phosphoric acid in the soil, but some danger exists that such a system might lead to the complete disappearance of all the leguminosae and a decrease in the cereal crops owing to the gramineae being unable to avail themselves of the stores of phosphoric acid at disposal.

The sugar beet is more capable than a leguminous plant in assimilating the phosphoric acid of the soil, but experiments made in Saxony with fertilisers containing only nitrogen and potash, produced such unsatisfactory beet crops that the utmost caution should be exercised in their use.

AEREBOE advocates, in some cases, the application of a dressing of 52 % chloride of potash with a view to stimulating the assimilation of

(1) This was the price at the beginning of 1922, subsequently it altered a little. In December 1922, one kg. of nitrogen (sulphate of ammonia) cost 1334.10 tl. and 1 kg. of phosphoric acid (superphosphate) cost 525 tl. (Ed.)

phosphoric acid. This may, however, easily have a bad effect on the physical properties of the soil, when the remedy would be worse than the disease.

Warnings against undue optimism.

According to MITSCHERLICH (IV), the only certain facts so far known about the use of phosphatic fertilisers are the following:—

The "phosphoric acid" forms one of the nutritive substances of plants and cannot be replaced by any other food material, hence the uselessness of a fertiliser in which this compound is lacking. When a soil contains a certain amount of easily assimilated phosphoric acid, a plant will absorb most of it when all the other factors regulating growth are most favourable. By increasing the nitrogenous fertiliser when the soil does not contain sufficient nitrogen, the crop is increased as well as the phosphoric acid assimilation. The phosphoric acid percentage in the crop, is however, not increased, but is even slightly diminished. This is equally true in the case of the other nutritive substances. When only nitrogenous and potassic fertilisers are used, the size of the crop will chiefly depend upon the readily available phosphoric acid present in the soil, and these reserves shrink from year to year. It is never a question of saving phosphoric acid. Leguminosae assimilate larger quantities of phosphoric acid than cereals, therefore they will exhaust the available supplies more rapidly.

It is possible that leguminosae may be able to obtain phosphoric acid from the more deeply-seated layers of soil, but no careful experiments have been made on this subject. Neither has it been scientifically established that these plants, or any others possess the power of rendering soluble, the less easily soluble phosphoric acid of the soil. Therefore AEREBOE'S theories are really worth very little. The phosphoric acid of compounds that are only soluble to a limited extent may be rendered available by the simultaneous application of sulphate of ammonia, on account of the acid reaction of the latter. (See: *Landw. Versuchsstationen*, Vol. LXXIX, 1911, pp. 71-96). It has long been known that a dressing of carbonate of lime lessens the effect of a phosphatic fertiliser. The results obtained with phosphatic fertilisers were however, very different in the case of different crops. Sometimes, excessively poor soils do not react at all upon a phosphatic fertiliser, but it is most probable that they contain phosphoric acid in a readily available form. Soils may be rich in phosphates and yet act distinctly on the phosphatic fertiliser. The total amount of phosphates present can be determined chemically, but this is no criterion of their availability. It may well be that in many cases the reserves of phosphoric acid in the soil are sufficiently large to enable crops to draw upon them for some time, and certainly phosphatic fertilisers have often been quite unnecessarily applied in East Prussia.

MITSCHERLICH considers that the abrupt cessation of all use of phosphatic fertilisers would be a great mistake and would ultimately result in diminished crops. Suitable experiments should be carried out on the different types of soil.

The importance of the different composition of soils.

Prof. HASELHOFF (III) has for many years conducted a large number of experiments on the use of phosphatic fertilisers. He emphasises especially the importance of the difference in the composition of German soils and compares four different types as follows :—

Bunter Sandstone	with	0.15 % phosph acid	0.5 % lime	
Greywacke	»	0.38 %	»	3.30 %
Muschelkalk	»	0.20 %	»	52.90 %
Basalt	»	0.77 %	»	11.00 %

The phosphoric acid of the Bunter Sandstone is much more soluble than that of the other rocks. The amount dissolved does not depend only upon the type of rock, but depends also upon the species of plant cultivated ; there are some leguminosae that absorb much more phosphoric acid than cereals. The Bunter Sandstone, though it contains the smallest percentage of phosphoric acid, yields the largest amount to the crop. The quantity abstracted by the crop decreases year by year. Leguminosae abstract from Bunter Sandstone 1.34 to 2.40 % of the total phosphoric acid present, whereas cereals only take 0.09 to 0.26 %. This difference is undoubtedly due to the more extensive root system of the leguminosae. The absolute amount of nitrogen absorbed by leguminous plants is also much greater than that taken up by the gramineae, and reaches the maximum in the case of the Bunter Sandstone. Apparently some correlation exists between nitrogen assimilation, the development of the plant and the capacity for rendering soluble the nutritive matters present in the soil. In using more nitrogenous fertiliser and this interfering with the absorption of atmospheric nitrogen, a great risk is run of decreasing the assimilation of phosphoric acid.

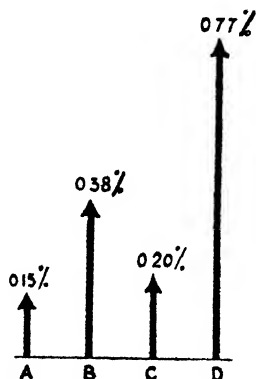


FIG 48 — Percentage of Phosphoric Acid in — A = Bunter Sandstone — B. Greywacke — C Muschelkalk. — D Basalt.

Whether a phosphatic fertiliser is necessary depends upon the fertilisers that have been previously applied, the working of the soil, and the

order of crop rotation, all factors that affect different soils in a different manner. No general rules can be laid down and the phosphoric acid content of the soil does not appear to be any guide.

HASELHOFF carried out a series of field-experiments under the following conditions: Soil: basalt containing 0.75 % lime (as previous experiments had proved liming this soil to be useless, no lime was applied). Fertiliser per hectare, per year; 20 kg. nitrogen (ammonia salts), 40 kg. citric soluble phosphoric acid (basic slags). 75 kg potash (kainit). Length of time of application, 5 years

Data per hectare for one year:

	Without fertiliser kg.	N + K + P kg.	K + P kg.	K + N kg.	2 K + 2 P kg.
Yield					
a) hay	3 030.0	5 826 0	3 838 0	3 524.0	4 788 0
b) protein	447 11	827.05	549.34	447 17	677 08
Extra yield due to fertilisers					
a) hay	—	2 706 0	808 0	494 0	1 758 0
b) protein	—	397 94	102 23	0 06	229 97
Total cost of fertilisers	—	2 047.00 mk.	051.00 mk	1 387 00 mk	1 902 00 mk.
Cost per 100 kg. of extra yield					
a) hay	—	73 18 "	115 92 "	280 77 "	108 19 "
b) protein	—	534 77 "	930 25 "	—	827.06 "

The maximum return was obtained from the application of N + P + K. The same quantity of hay, containing more protein, was produced at less cost by using this fertiliser rather than the others. Production cost is increased by the application of a fertiliser containing no nitrogen; it is advisable to increase the amount of P and K. A fertiliser without phosphate gives bad results. In all these experiments the highest yield was obtained from the application of a fertiliser containing both phosphate and potash.

The results of another series of experiments prove that nitrogen in the form of ammoniacal salts increases the solubility and availability of the phosphoric acid present in crude phosphates. Potassic salts were found to have a similar effect upon basic slags and ground bones. According to HASELHOFF, physiologically acid salts, whether potassic, or nitrogenous, have a favourable effect on the solubility of phosphates and facilitate their assimilation by plants.

The practical point of view. — Hitherto, it has been the rule to apply a phosphatic dressing in such a manner that its most expensive ingredient, nitrogen, should be utilised to the maximum extent by the crop. This system led in many cases to an exaggerated use of phosphatic fertilisers. Prof. OTTO LEMMERMAN estimates that about $\frac{1}{3}$ of the phosphoric acid used in Germany before the war is now available there, also the price

of superphosphate has increased as compared with that of other fertilisers.

In that country there are however, a whole series of soils which react little, or no longer at all, on a phosphatic fertiliser and theoretically could well be left without any, until such time as the reaction again appears. Practically, however, the agriculturists are not always in a posi-

3467

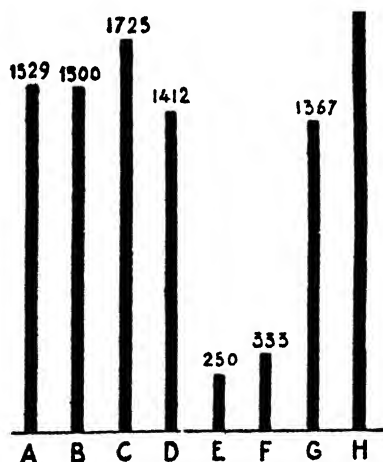


FIG 49 — Increase in Price of Cereals from 1913 to December 1922 — A = rye — B = wheat — C = oats — D = barley — E = potatoes — F = beets — G = hay — H = straw

tion to apply tests to ascertain when this moment arrives, hence they would do well to replace annually the amount of phosphoric acid that has been removed from the soil by the crops. In this way a great economy in phosphoric acid would be effected. The average amount of phosphoric acid abstracted from the soil by crops may be estimated at 160 kg. per hectare. By means of a fertiliser, some 60 kg. are applied in 4 years,

which gives a deficit of 100 kg. in 4 years, or of 25 kg. per annum. This means, it is necessary to use 1.4 quintals of 18% phosphate or 1.6 quintals of 16% basic slag every year, instead of applying 60 kg. of phosphoric acid per hectare as has frequently been done.

LEMMERMANN is not of opinion that Germany ought at all costs to abandon the use of foreign phosphates, for the aim of the country should be to obtain maximum yields, therefore it is better to purchase foreign phosphates than to be obliged to buy food directly from abroad. The present economic condition of Germany may become still worse, therefore the moment of adopting AEREBØE'S system, which is a last resort, should be deferred as long as possible.

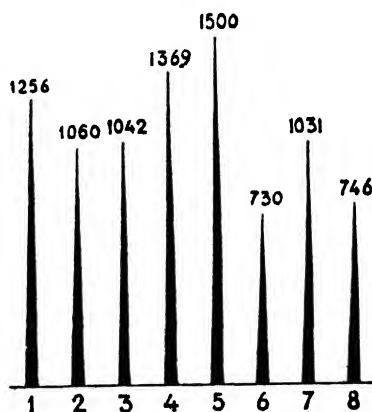


FIG. 50 — Increase in Price of Fertilisers from 1913 to December 1922. — I. Nitrate of Soda — II. Sulphate of Ammonia — III. Calcium Cyanamide — IV. Basic Slag — V. Superphosphate — VI. Kainit. — VII. 40 % Potash Salts. — VIII. Chloride of Potassium.

The present scarcity of nitrogen already prevents the excessive use of nitrogenous fertilisers, further, now, as formerly, nitrogen is much more expensive than phosphoric acid. In February 1922, one kg. of nitrogen in the form of sulphate of ammonia cost 29.80 mk. and as cyanamide cost 26.50 mk., whereas the price of phosphoric acid in the forms of superphosphate and of basic slag respectively, was 15 and 7.50 mk.

Between 1913 and the beginning of 1922, the price of nitrate of soda increased 28 times, sulphate of ammonia 23; cyanamide 23; basic slag 28; superphosphate 43; kainit 22 and of 40 % potassic salts 24 times. During the same period, the prices of the different cereals and other products increased as follows: Rye 43 times; wheat 49 times; oats 43; barley 47; potatoes 43; beets 50 and hay 43 times. (In December 1922, the prices had risen as shown in figs. 49-50. — *Ed.*)

As nitrogen is the most expensive fertiliser, it must still be used in the most economical manner. The amount of the yield depends primarily upon nitrogen, therefore the other fertilisers must be adapted to

application with this element. It is however, necessary to limit the use of phosphatic fertilisers for the simple reason that phosphates are not to be had, but AEREBOE'S system will certainly not be generally adopted.

The productive value of phosphoric acid is higher than that of nitrogen, viz. 1 gm. of phosphoric acid may produce 100 gm. of oat grain, whereas, only 28 can be obtained from the use of nitrogen. Another point to be noticed is that lack of phosphoric acid will cause a greater absolute decrease in the yield than even want of nitrogen.

As regards the question whether leguminosae have more power than gramineae to render available phosphates that are very difficult to make soluble, LEMMERMANN draws attention to the fact that all the experiments made in this direction have been carried out in pots filled with quartz sand, therefore it is not permissible to regard the results obtained as representing the behaviour of leguminosae towards the phosphates of the soil.

The process recommended by AEREBOE has been going on in the soil for centuries. The insoluble phosphates have become increasingly soluble, and at the present moment are far more soluble than AEREBOE thinks. Further, many soils contain the remains of fertilisers, as plants generally use only 10 % of the fertiliser applied. Most soils contain more soluble, than insoluble phosphoric acid;

Soluble in 10 % hydrochloric acid	=	70 - 100 parts
" " 1 % citric "	=	37 - 70 "

according to the nature of the soil. In many soils, as much as 50 % of the phosphoric acid is present in the form of organic compounds

Green manuring with leguminosae, according to AEREBOE, will probably not hasten to any considerable extent the conversion of insoluble phosphoric acid into soluble and available phosphoric acid. Hence to apply a nitrogenous fertiliser to leguminosae with the object of rendering the phosphoric acid soluble would be sheer waste, more especially seeing that the supplies of nitrogenous fertilisers are limited, and other fertilisers cannot always be used instead of them in the case of pastures. (See B. TACKE, *Neue Erfahrungen auf den Gebiete des Moor und Marschkulture* 1921, and STUTZER, *Die Düngung der wiesen und Weiden*, Verlag, P. Parey).

LEMMERMANN considers AEREBOE'S suggestion of using chiefly physiologically acid fertilisers to be very dangerous advice, for by this means the soil would be made so acid that the plants would suffer. Moreover, the agriculturist could never produce a soil reaction sufficient to allow the physiologically acid fertiliser to act upon the phosphates in the soil (assuming the practical utility of such action), and at the same time prevent the injurious effect of its acidity.

The agriculturist would do well to abstain from such risky experiments and to turn his attention to using expensive chemical fertilisers economically and maintaining a neutral reaction in his soil.

D. V. S.

*Agricultural Meteorology.***161. Weather and Crop Yield.**

WARREN SMITH, J. Influence of the Weather on the Yield of Crops. *Monthly Weather Review*, No. 50, Part. II, pp. 567-572. Washington, 1922.

The Yearbook of the Department of Agriculture for 1903 contains some graphs plotted by the author to show the connection between the maize crops and the rainfall during the summer months (taken separately and also together in different combinations), in the most important maize-growing areas of the United States of America.

Subsequently, the *Monthly Weather Review* published an article in February 1914, and in May 1915, respectively dealing with the effect of weather on maize and potato crops. These studies, like others of the same character, showed by means of the correlation coefficient the close connection existing between crop-yield and meteorological phenomena.

Both the graphic method and the statistical (formulae of correlation and retrogression) are very useful. In the first case, curves are plotted giving the relation between the two factors, while the statistical data show the atmospheric conditions that have most influence upon the yield, and make it possible to determine the critical periods. In work of this description, the dot-chart and the coefficient of partial correlation have proved themselves of great service.

In the course of their studies, the author and his fellow-workers soon found that the use of monthly values was not satisfactory, and that it was necessary to take shorter intervals.

During the last two years, the Division of Agricultural Meteorology of the Meteorological Office has determined the weekly average and sum of the rainfall, temperature and hours of sunshine for single States or for groups of Counties, in the most important agricultural districts. Very satisfactory results were obtained on the basis of weekly values, thus proving the week to be the best time unit.

The crops studied were: oats and maize in North-Central Illinois and cotton in South Carolina.

Oats. — Many charts, diagrams and mathematical calculations were made to ascertain the critical periods, the most favourable times for rain, etc.

These studies confirmed previous investigations and showed that oats grow best in comparatively cool, damp climates.

In order for oats to thrive in North Ohio, Indiana, Illinois and Iowa, April should be moderately dry for the sowing, and relatively warm to insure quick germination. During June if the weather is cooler and somewhat damper than normal, heading is encouraged and the crop ripens more regularly. Too much heat and dry weather during the setting of the grain is very injurious. It was also found that a cold winter has a bad effect upon the yield.

The investigators decided to confine their attention entirely to the unfavourable weather conditions affecting crops as great efforts had al-

ready been made to establish empiric relations between favourable and unfavourable meteorological factors and crop yield. The little that had hitherto been done in this way was, however, of great use in assisting them to calculate the yield on the basis of meteorological values.

They made an estimate of the unfavourable effects of the weather conditions considered to be injurious and took the sum of them for the period March 1-August 31, thus obtaining a "Weather index" for the year in question.

The results relating to oats are collected in the following Table.

TABLE I. — *Effect of the weather upon the oat crop of North-Central Illinois for the period 1894-1920.*

1	2	3	4	5	6	7
Year	Weather index	Actual crop Y	We	W × Y	theoretical crop Y	Difference between the theoretical and actual crop = Y
1894.	17	40 5	289	688.5	39 5	- 1 0
1895.	40	16 2	1600	648 0	16.8	+ 0 6
1896.	28	29 9	754	837 2	28 6	- 1 3
1897.	21	36 9	441	774 9	35 6	- 1.3
1898.	32	24.9	+ 024	790 4	24.7	- 0 1
1899.	12	41.5	144	34 0	44 4	- 0.1
1900.	13	43 6	169	566 8	43.5	- 1 5
1901.	25	33 1	625	827 5	31 6	- 0.3
1902.	15	41.8	225	627.0	41 5	- 0.5
1903.	28	29.1	784	814 8	28.6	- 1 7
1904.	26	32 3	676	839 9	30.6	- 0.8
1905	16	41.3	256	660 8	40 5	- 0.9
1906.	27	30.5	729	823 5	29 6	- 0.8
1907.	29	28 5	841	826.5	27.7	- 1.5
1908.	36	20 7	1296	745 2	20.7	- 2.2
1909.	22	36 1	484	794.2	34.6	- 1.8
1910.	23	35 8	549	823.4	33.6	- 0.4
						+ 0.3
1911.	28	30.4	784	851 2	28.6	- 2 3
						- 0.1
1912.	11	45.8	121	503 5	45.4	- 1.2
1913.	32	24.4	1024	780.8	24.7	+ 0.4
1914.	24	34.9	576	837.6	32.6	-
1915	11	45.5	121	500.5	45 4	-
1916.	20	37.7	400	754.0	36.5	-
1917.	8	48.0	64	384.0	48 4	-
1918.	16	41.3	256	660.8	40.5	- 0.8
1919.	29	27.7	841	803.3	27 7	0
1920	19	38.7	631	735.3	37.5	- 1.2
Sum . . .	608	939.9	15.444	19.433.8	—	—
Average . . .	22.6	34.8	—	—	—	0.82

On the basis of the weather index and of the data respecting the yield, by means of the method of least squares, a retrogression equation is obtained $y = a + bw$, as is seen from the table.

The value of a is found to be 56.2 and that of b equals $a - 0.998$; w is the weather index; y the yield calculated by the equation in question, v is the difference between the real value and the calculated value. This, during a period of 27 years, is on an average only 0.8 bushel an acre (2 % of the average crop), with a maximum of 2.3 (6 % of the average crop), as found in 1914.

The correlation coefficient for the weather index and the yield data is 0.994 ± 0.012

The retrogression equation shows that the maximum oat yield for the whole area under examination may exceed 56.3 bushels per acre.

Maize — This is a sun-loving plant of tropical origin endowed with much plasticity, that can quickly adapt itself to new surroundings, and in consequence its present area of distribution is very extensive.

The zone of the most intense maize cultivation in the United States has an average summer temperature of 70-80° F., and an annual rainfall of 605-1250 mm, the rainfall from July-August being 175-200 mm. Preceding studies made by the author and other investigators had already demonstrated the most decisive meteorological factor, as regards the annual variations in the crop in North Ohio and the Central Valley of the Mississippi, to be the total rainfall in July. It is however, true that other factors as well as rain influence the yield; J. B. KINCER had already found a high coefficient correlation to exist between the temperature of June and the rain during July.

The author, encouraged by the success he obtained with oats, has carried out a similar study in the case of the maize crops of North-Central Illinois. Here again, it was possible by taking into consideration only the adverse factors, to obtain a weather index from which to state a retrogression equation

Since the most important critical periods occur before August, it has been regarded as expedient in working up the meteorological data to consider only the period up to August.

In order to find y , the equation $y = a + bw$ was used. The most constant value of the constants a and b is found by the solving of two simple equations, which are in the present case; $a = 52.1$ and $b = 0.8784$; substituting for the symbols the calculated values, we get: $y = 52.1 - 0.8784 w$.

By means of this formulæ y can be calculated on the basis of the sum of the rainfall throughout July and an exact forecast of the crop made a few weeks before the harvest.

The coefficient of the correlation between the weather index, w , and the actual yield Y is -0.9797 ± 0.012 .

Thus, the actual and theoretic values agree very well, and the average difference between the actual and theoretical yield is 0.69 bushels.

Cotton. — Taking the broad features of the climatic reports of cotton in the United States, an excess of rain is noticed in the east part of the

cotton-belt during the first growth period, and pronounced drought in the western portion during the second vegetative period. Owing to the herbaceous mode of growth of this plant, the long duration of its flowering and fructification season, and hence the probable absence of short critical periods, it had been thought impossible to distinguish intervals of limited length during which the meteorological factors exercised a dominant influence. Two years ago however, the author succeeded in discovering a fairly high correlation coefficient between the yield and the weather conditions during one week in June. The correlation was sufficient to allow of a forecast of the crop being made from that time.

An attempt has therefore been made to determine a weather index and a retrogression equation also for cotton with special reference to South Carolina, the season till the end of June being included in the study.

The retrogression equation is: $y = a + bw$; where $a = 364.0$ and $b = -15.569$. The coefficient of correlation between W and $Y = -0.927 \pm 0.0147$. G. A.

162 The Resistance shown by numerous Varieties of Wheat at Svalöf during the Winter 1921-1922.

AKERMAN A. Jakttagelser torande hostsadens övervintring vintern 1921-1922. *Sveriges Utsädesförenings Tidskrift*, Year XXXII, Part 5, pp 252-260. Svalöf, 1922.

The winter 1921-1922 was extraordinarily severe throughout North Europe. In Scania (South Sweden), the temperature remained for a long time below zero even in the afternoon, and fell at night to -15°C , or lower. This strong thermic depression coupled with the prevalence of very bitter winds did great injury to the wheat fields, causing large bare patches and extensive gaps in the crops, especially in places where the ground was free from snow, the area destroyed being between 5 and 10 %.

Such a winter afforded an excellent opportunity for observing the cold-resistance of the various types of wheat at Svalöf. The author gives the results of his investigations in this connection.

Sowing was done on September 15. In the period from the 7-12 November, the first cold weather set in, the temperature falling to 11°C , which injured some of the seedlings. The lowest temperatures were however in January-February, especially from Feb. 3-8 when the thermometer registered -15°C . on two nights, while most of the ground was not covered with snow.

Where the snow reached a depth of 10-12 cm. the thermometer did not fall lower than -8°C ., a temperature that can be borne even by varieties of wheat that are susceptible to cold.

According to previous observations, the most resistant varieties would be sure to suffer from a fall of the temperature to -18°C ., which proved to be the case in this instance. The scale of resistance values for the different varieties must however, be determined by reference to the range of temperatures included between -8° and -18°C .

The drought of the third week in April still further increased the

damage caused by the cold, and the seedlings which had suffered most, withered completely. In March and April also there were frosts and great oscillations of temperature with alternate frosts and thaws which, in the opinion of agriculturists, is peculiarly fatal to wheat crops.

The author, however, found that those plots which had been protected by snow during the March-April period suffered little from the inclement weather.

The decisive factors to which must be attributed the gaps in the fields were the minimum temperatures of the winter season.

In 1901, when it was necessary to resow in the spring 50 % of the area under autumn wheat, the cold period came in January. Low temperatures occurred at the same time in 1905, 1908, 1909, 1912 and 1917.

In order to estimate the degree of cold-resistance, an empirical scale of values was taken ranging from 1 to 10: 10-9 very good; 8-7 good; 6-5 average; 4-3 bad; 2-1 very bad. The average data are given in the following Table (Table I).

TABLE. — *Relative Data of Cold-Resistance of Wheat*
(*Empirical Scale ranging from 1 to 10*).

N°	Lines	Degree of Resistance
1	0881 C1 Extra Square-head III	5.0
2	0865 C1 Birgittawete	6.0
3	0902 b Solvete III	8.0
4	0982 a, result of Cross Sol II × Pansar	7.0
5	0802 Pansarvete II	6.0
6	0984 b, result of Cross Sol II × Pansar	8.3
7	0985 b2	5.8
8	0986 b	5.3
9	0987 b	6.5
10	0987 b	7.3
11	0990 b	9.0
12	0806 from Pansar	5.8
13	0802 from Pansar II	5.8
14	0808 from Pansar	7.3
15	0809 from Pansar	5.5
16	0952 b from cross Pansar × Fylgia	4.0
17	0966 a from cross Pansar × Fylgia	4.5
18	0960 b Riddarvete	6.3
19	Weibulls' Standard	6.8
20	0860 d from Fylgia	7.8
21	Tystofto Smaahvede II	3.8
22	01032 from cross Sol II × Wilhelmina	4.8
23	0802 Pansar II	6.0
24	Wilhelmina	2.5
25	0971 from Pansar II × Wilhelmina	2.5
26	0973 from Pansar II × Wilhelmina	2.5
27	0700 Sammetvete (Swedish)	8.3

The best results were thus obtained with the Opland Sammettsvete, Sol II and the two new kinds, 0984 b and 0990 b. The behaviour of 0860 d, a line of Fylgia, was also fairly satisfactory; this wheat was also distinguished by high yield, the good quality of the grain, and early maturity, but it had the defect of possessing weak straw.

Weibulls Standardvete, 0808 (from Lansar), 0982 and 0987 b, from Sol II \times Pansar, as well as Riddar (a hybrid resulting from the cross Pansar \times Fylgia) were all resistant to a considerable degree.

The study of the many lines resulting from the cross of Pansar \times Riddar was particularly interesting. Most of them were intermediate in character. Only lines 58, 70, 72, 73, 76 and 77 proved inferior to their parents, while lines 55 and 69 were superior to them. This can be explained by the fact that the old Pansar was not yet fixed as regards the character of cold resistance, and the line used for the cross resulting in the formation of Riddar had different genetic factors governing resistance from those present in Pansar II. In those lines derived from Pansar II \times Riddar which were superior to their parents (lines 55 and 69) it is probable that the sum of the positive resistance factors of the two lines, or stocks, of Pansar were present. Similar phenomena were also to be observed in the series Pansar \times Sol II with considerable deviation in the positive direction (above the parents) and in the negative direction (below the parents).

Tystofte Smaahvele and Wilhelmina (Wilhelmina \times n) gave the worst results.

For the old varieties we have: Extra Squarehead I (= 8), II (= 6), III (= 7); Sol (= 7); Notte (= 7), Sveavete (= 9); Grenadier (= 3).

The English wheats: Red Standard, Galton's Victor; Yeoman, Benefactor and Squarehead were all practically destroyed.

From previous investigation it seemed that an increase in the sugar content of the cell sap would increase the resistance to low temperatures. These experiments were repeated on a large scale, and a short summary of the results obtained as given in the following table where the sugar content is expressed in percentage of the dry matter and in relative numbers referred to the native Swedish wheat which is taken as 100.

Native Swedish	100	Pansar	56
Svea	78	Extra Squarehead III	51
Thule II	72	Smaahvele II	47
0860 d	63	Wilhelmina	44
Sol II	62	Vårparl	30
Birgitta	59	March Wheat of Holland	26

The parallelism between the sugar content and the cold-resistance is very noticeable. The results given in the above table exactly correspond to the cold resistance classification already made by NILSSON EHLE (the values in decreasing order are as follows):

- 1-3) Native, autumnal wheats of Central Sweden.
- 4) Svea.
- 5) Thule II.
- 6) Pudel, 0912 (sister line of Sol II).

- 7) Bore ; Sol II ; Standard ; Birgitta and 0869 d.
- 8) Riddar, Pansar, 0806 (from Pansar), Sol I.
- 9) Extra Squarehead II and III ; Fylgia.
- 10) Smaahvide II.
- 11) Grenadier.
- 12) Wilhelmina ; Stand-up.
- 13) English Squarehead, Vårpär (March wheat).
- 14) Kolben (March wheat).
- 15) Börsum March wheat, and Dala and Holland March wheats.

The pubescent, native variety which is most resistant to cold has also the highest sugar percentage. Svea is the most resistant of all the lines obtained by crossing and it also contains a large amount of sugar. In comparison with the indigenous variety however, it shows a great difference (22 points) ; this proves the difficulty of combining in a single type the resistance and hardness of the local wheat with the high yield and other valuable qualities of non resistant varieties.

Lines 0860 d, Sol II, and Birgitta have about the same percentages and their resistance is equal.

The superiority of Pansar over Extra Squarehead III is accompanied by a higher sugar content

Smaahvide and Wilhelmina give rather low percentages, as do also the March wheats, of which latter, as was said before, the greater part was destroyed by the frosts.

G A

Pedology.

163 **Carbonic Acid Production and Gas-Permeability of Soil.**

LUNDEGORDH, H Ueber die Kohlensäureproduktion und die Gaspermeabilität des Bodens — *Arkiv för Botanik (K Svenska Vetenskapsakademien)* Vol 18, No 13, pp 1-36, figs 3, diagrams 3, bibliography Stockholm, 1923.

The discovery that plant assimilation depends largely on the amount of carbonic acid in the atmosphere invested the question of the natural production of carbonic acid by the soil with greater importance as by this means the CO₂ concentration of the air in forests especially but also to some extent over fields, is considerably increased. In order to be able to judge of the natural assimilation conditions of plants, it is most important to determine accurately the amount of CO₂ produced by the surface unit.

The author describes several special methods for the determination of the CO₂ production of free soil (soil respiration), and also for the estimation of the absolute CO₂ production of soil at different depths. A very simple mathematical relation exists between free soil respiration, the absolute CO₂ production by the soil mass, the carbonic acid concentration of the air and the permeability of the soil by gases.

In homogeneous soils, the quotient $\frac{\text{soil respiration}}{\text{CO}_2 \text{ concentration of soil air}}$ gives the permeability. In heterogenous soils, the absolute CO₂ production must also be taken into account. In determining carbonic acid formation

and concentration at different depths in the soil, the permeability of the different layers may be considered. Permeability is directly proportional to the diffusion coefficient and by which it may be expressed.

If a represents the absolute CO_2 production, b the difference between the amount of CO_2 present in the soil air and in the free air, M the CO_2 production at the surface, and P the permeability of the soil, the relations of these factors may be expressed by the following equations:

$$ka = M(1) \text{ and } b = k_r \frac{a}{p} (2) \text{ where } k \text{ and } k_r \text{ are constants.}$$

From these equations we get:

$$P = k_r \frac{M}{kb} (3) \text{ and } P = k_r \frac{a}{b} (4). \text{ } P \text{ is the inverse expression for the resistance to diffusion.}$$

$$P = k_r \frac{M}{b} (5).$$

In determining the total CO_2 production and also the surface respiration which is found separately, we must not forget to subtract the carbonic acid fixed in the soil (by the phosphates, for instance), and the amount removed by water. The largest quantity, however, reaches the surface through diffusion.

The permeability of the soil can be increased by ploughing and harrowing; it also increases as the soil dries out.

Permeability is diminished by physical density and decreases with the depth of the strata.

There is much variation in the distribution of the absolute CO_2 production (soil activity). In some cases, it is uniform, while in others it is not, and it may decrease with the depth of the layers. The production of CO_2 , in proportion to soil weight, always diminishes with the depth of the strata. Being a biological phenomenon, it can be accelerated by many factors that stimulate the propagation of microorganisms, e.g. by moisture, provided this does not decrease the soil permeability; dung which is very effective when dug in deep; dilute solutions of certain salts, and by better aeration of the soil. The hydrogen ion concentration (with pH reaction ranging from 3.7 to 7.3), and the presence of humic substances, have no effect upon carbon dioxide production. Soil activity can be increased 800% by artificial means such as the application of a fertiliser.

The free respiration of the soil liberates about 0.4 gm. CO_2 per m^2 and per hour in the case of arable land, but this figure can be increased several times by fertilisers. Forest soils liberate much more CO_2 than any other soils. The amount of carbon dioxide freed by the soil is the same as the quantity used in assimilation. It is possible by means of suitable fertilisers to obtain a higher concentration of CO_2 in the neighbourhood of assimilating leaves.

D. v. S.

164. The Effect of Sudan Grass on the Biological Processes in the Soil.

EMERSON, P. and FLETCHER, R. D. (Assistant Professor of Soils and Assistant in Soils, Iowa State College Ames, Iowa). *Journal of the American Society of Agronomy*, Vol. 14, No. 6, pp. 234-241. Geneva, N. Y., 1922.

Sudan grass has been cultivated to a large extent ; it may be described as a heavy soil feeder ; the ash content is over 6 % and the growth is very rank. The Iowa Agricultural Experiment Station has for several years made a study of the effect on the soil of the grass, on a 4-year rotation. From the results obtained it may be concluded that there is a depletion of nitrogen and phosphorus and indirectly of carbon, compared with prairie soil and clover soil, but an increase of acidity over the clover soil. It is surprising, however, that the nitrate nitrogen is higher in the Sudan grass soil than in the others.

It is difficult to interpret the crop producing power of a soil by numbers of micro-organisms alone. The authors have found that the number of bacteria in the Sudan grass soil is much lower than in the clover soil, and still lower in the prairie soil. The number of organisms per gramme of air dry soil (LIPMAN and BROWN's modified synthetic agar) was 4822, 1523 and 747 bacteria respectively.

Although the total bacterial content of the soil is lowered, apparently Sudan grass does not interfere with the physical activities of the micro-organisms concerned in the production of available plant food. The nitrifying of dried blood and ammonium sulphate was more marked than in the case of the other two soils (prairie soil showed no action) ; the ammonifying power with cotton seed meal was only slightly less. For example 5 c. c. of fresh soil infusion inoculated into 100 c. c. 1 % LIPMAN and BROWN dextrose solution, gave an average of fixed nitrogen per 1 gni. dextrose of 5.60 (clover), 5.81 (Sudan grass) ; 5.04 (prairie).

Results obtained in greenhouse tests with wheat on similar potted soils are given. The highest weight were recorded with Sudan grass soil ; for example when a complete fertiliser + manure + lime was used the results were as follows (dry weight in gms.) : Sudan grass 14.2 ; clover 12.9 ; prairie 9.1.

Apparently, it may be concluded therefore, that Sudan grass does not reduce the crop-producing power of the soil, nor does it influence the favourable effect of the fertilisers.

L. V.

165. Soil Protozoa.

PEREY Mdle. M., Les protozoaires du sol. (État actuel de la question et quelques récentes observations). — *Annales de Science agronomique française et étrangère*, Year 39, No. 6, pp. 333-353, 1 pl. bibliography. Paris, 1922.

For some years past, it has been recognised that bacteria are not the only micro-organisms present in arable soil. The population of a normal soil should be regarded as complex, as this complexity is of paramount importance from the standpoint of soil fertility. The protozoa may be considered as the limiting factor of bacterial activity ; they are certainly

less numerous than the bacteria, but their total volume per gramme of soil exceeds that of the bacteria. Protozoa in soil may be destroyed by toluene and other antiseptics of sufficient strength to kill the nitrifying organisms, and also by heating to 50°C. If the soils are protected from re-infection, the protozoa never appear again, even if the conditions are favourable to the development of bacteria. The protozoa are temporarily inhibited by heating to a lower temperature than 50°C, or by drying for some hours at 35-40°C., and also by low temperatures, but the limiting action soon shows itself again under normal conditions of temperature, moisture and aeration. By the addition of a little untreated soil, protozoa can again be introduced into soil from which they have been wholly eliminated. They develop more slowly than the bacteria, and for a time may have little or no effect.

A thorough knowledge of the life-history of protozoa would be useful. Those inhabiting the soil belong to the following three large groups. *Rhizopoda* or *Amoebae*, *Mastigophora* or *Flagellata* characterised by one or more processes known as flagella, and *Ciliata* characterised by the presence of numerous cilia disposed on their bodies in different manners. The author mentions a certain number of species occurring in the soil of Rothamsted and found in soil samples sent from the neighbourhood of Havre and Rouen.

METHOD OF ESTIMATING THE NUMBER OF PROTOZOA IN SOIL. The protozoa of the soil may pass through two different phases during the course of the existence, the encysted, or resting stage and the active, or trophic stage. In the first stage, the organisms take on a rounded form and are enclosed in thick, resistant cell-wall. In this resting condition they remain for variable periods. In the second or active phase, the protozoa are mobile, absorb food and reproduce themselves.

In order to estimate the number of protozoa, as direct counting is impossible, recourse must be had to the dilution method. The soil samples are first extracted with sterilised water and the required series of dilutions made. Some of the sowings can be effected on agar in Petri dishes, which are examined at regular intervals to determine whether there are any protozoa present. In this way, it is possible to reckon approximately the number of protozoa in 1 gm. of given soil, but it cannot be known whether the protozoa that make their appearance in the dishes after incubation at 20°C. are derived from resting or active forms. In order to decide this question, a similar sample is treated for 24 hours with 2 % hydrochloric acid, this dilute solution being sufficient to destroy all the active forms, while it does not kill the cysts. The protozoa in the soil treated with hydrochloric acid are then counted and the difference in the figures obtained from the treated and untreated samples gives the number of cysts. On subtracting the latter from the total, we obtain the number of active forms. The author used dilutions ranging from $\frac{1}{4}$ to $\frac{1}{409600}$ for the total count, and from $\frac{1}{25}$ to $\frac{1}{102400}$ for the series of cyst counts. In each series, the number of protozoa contained in 1 gm. of soil was reckoned from the number of plates giving negative results (containing no protozoa), this method being adopted in the case of each series and of each organism identified. The number of protozoa and bacteria is found to vary

enormously within very short periods of time (24 hours). Bacterial counts made at long intervals are therefore without any value, so that a change must be introduced in the former methods of investigation.

A very striking inverse relation exists between the numbers of bacteria and of active amoebae in the same soil sample, but no connection has been established between the number of bacteria and of active flagellates. The authoress also made a study of the comparative effects of chemical fertilisers and of stable-manure upon the number of protozoa, and found that the plot manured with dung was able to support a far larger number of these micro-organisms than any of the other plots.

The authoress is therefore of opinion that before trying to explain the function of protozoa in the promotion of soil fertility, it would be well to extend our present knowledge of the life-history of these soil organisms.

D. V. S.

166. **Arsenate of Sodium in Soil Sterilisation.**

RIVIÈRE GUSTAVE (Directeur de la Station agronomique de Seine-et-Oise) and RICHARD GEORGES ("préparateur chef" at the above Station). De la stérilisation partielle du sol au moyen de l'arséniate de soude. — *Annales de la Science agronomique française et étrangère*, Year 39, No. 6, pp. 366-370. Paris, 1922.

The author concludes from the results of his experiments that arsenate of sodium in small quantities (two or four gm. per square metre) has no injurious effects upon farm crops, but is sufficiently toxic to kill the protozoa which destroy the useful soil bacteria. Like other similar substances, sodium arsenate exercises indirectly, a fertilising action.

D. V. S.

167. **Some Transvaal Soils.**

HALL, T. D. (Research Chemist, School of Agriculture and Experiment Station, Potchefstroom). *Union of South Africa, Department of Agriculture, Bulletin*, No. 5, p. 36. Pretoria, 1922

Part I deals with investigations on some highly calcareous soils, on certain irrigated wheat areas where there has been a decided decrease in yield, giving rise to considerable alarm amongst farmers in that district. These soils contain from 50-96 % of carbonate of lime; Nitrification in these soils appears to be quite normal, except where there is a poor water holding capacity and lack of organic matter. Money should not be spent on nitrogenous fertilisers, but green manuring should be practised if plenty of farmyard manure is not available. The chief investment should be in phosphates (superphosphates at the rate of 200-500 lb. per acre per annum); the potash in the reddish-brown loam is sufficient.

Part II deals with soils of the Eastern Transvaal low Veld, of granitic origin. In spite of the variation in soil types, the samples examined required very similar treatment. Many of the soils are deficient in organic matter and thus in water-holding capacity, which hinders nitrification; this condition would be improved by a rotation

which includes a leguminous crop, where farmyard manure is not available in sufficient quantities.

The chief mineral deficiency is in phosphates which is a necessity for all crops. An application at the rate of 100-200 lb. per acre on dry lands and 200-400 lb. per acre on irrigated lands is advised (depending on the nature of the crop). Potash on the poorer soils is recommended, especially for root crops and tobacco, and very often also in citrus and pineapple cultivation. The author considers that farmyard manure can be used in every case at the rate of 4 tons to 400 lb. of superphosphate or bonemeal, but the manure should be protected from rain, if allowed to dry in the sun it is also apt to lose nitrogen.

Recommendations for special crops are given : cotton, tobacco, citrus fruits. L. V.

Fertilisers and Manures.

168 The Importance of Magnesium as a Fertiliser.

I. — POPP, Prof. M. and COUTZEN, Dr. J., Die Bedeutung einer Magnesia-düngung für unsere Kulturpflanzen. — *Landwirtschaftliche Jahrbücher (Zeitschrift für wissenschaftlicher Landwirtschaft)*, Vol. 58, No. 3, pp. 313-355 Berlin, March 1923

II. — GARNER, W. W., MAC MURTREY, J. E., BACON, C. W., and MOSS, E. G. (Contribution from Bureau of Plant Industry and North Carolina Agricultural Experiment Station), Sand Drown, a Chlorosis of Tobacco due to Magnesium Deficiency and the Relation of Sulphates and Chlorides of Potassium to the Disease — *Journal of Agriculture Research*, Vol. XXIII, No. 1, pp. 27-41, 7 pl., bibliography Washington, 1923.

Volcanic soils are mainly composed of silico-magnesian compounds. Magnesium is absolutely necessary to plants, for chlorophyll is an organic compound containing 2.7 % of magnesium (WILLSTÄTTER, Untersuchungen über Chlorophyll. Berlin, 1913).

The author made some manurial experiments with magnesium from which he has drawn the following conclusions :

The application of magnesian salts in addition to different potassic salts, or of commercial potassic salts containing a certain amount of magnesium, does not materially increase the yield of different crops, although some good results have been obtained, but there were many cases of failure. Since the physiological reaction of the fertilisers is an important factor in crop yield, soil reaction must be taken into account as well as the reaction of the fertiliser. The potassic content of a plant depends upon the potassic fertiliser, but it is not, however, possible to tell from the amount of potash present in the plant whether enough potassic fertiliser has been applied. Indeed, it sometimes happens that a crop which has failed owing to lack of potash in the fertiliser has a higher potash percentage than a crop dressed with a potassic fertiliser. This is especially true in the case of grass, but may also occur in that of straw.

The magnesium content of crops has often been inaccurately determined; thus for instance, STUTZERS well-known tables (in Mentzel's calendar) require revision. The amount of magnesium present in plants is little affected by a potassic fertiliser. The application of physiologically acid or alkaline magnesium salts has practically no effect on the magnesium content of the crop. Various plants use the magnesium of the soil to a different extent. Rye-grass assimilates most, then potatoes and tomatoes, and last of all rye, which assimilates very little of this element.

The solubility of the magnesium salts of mineral soils in a solution of ammonium chloride cannot be taken as any criterion of their assimilability by plants, for the values obtained from the solution are far too high. The potash of the soil is probably taken up at the same time as the magnesium but larger amounts of the potash are utilised. The application of physiologically acid potassic salts has little effect upon the utilisation of the soil magnesium; but physiologically alkaline salts may decrease it. Dressing with magnesian salts only influences the utilisation of potassic salts in cases where physiological reaction comes into play. No direct action of the magnesium has yet been found. Salts of magnesium when added to a fertiliser are very little used by plants; the sole exception to this rule is in the case of the tomato, which bears a large number of leaves and absorbs considerable quantities of these compounds. The potato, on the other hand, utilises a magnesium fertiliser to a very limited extent and therefore derives no benefit from it. The magnesium present in commercial potassic salts is not used differently. Neither the potato, nor any other plant, shows a preference for any special potassium salt.

Since the amount of magnesium present in the soil is certainly sufficient for the crops grown, the application of magnesian salts seems superfluous.

The results of the author's experiments do not always agree with practical experience. Thus for instance, the beneficial effect on potatoes of the double sulphate of potassium and magnesium cannot be denied. It may, however, be supposed that the physiological reaction is of prime importance in this case. The problem can however only be solved by means of field experiments.

II. Magnesium appears to be of great importance in tobacco-growing.

Chloride of potassium tends to influence the burning properties of tobacco and sometimes produces an undesirable colour, therefore it is well to use sulphate of potassium in conjunction with sulphate of magnesium. Experience has proved that potassic salts such as kainit and others containing more or less magnesium, give better results than the pure sulphate. Very pure potassic salts ought not to be used for dressing tobacco. A total absence of magnesium produces tobacco chlorosis (sand drown). This disease can be cured, and even prevented, by adding small quantities of magnesium to the fertilisers employed. How far the experimental results obtained in the case of tobacco disease due to lack of magnesium can be applied to other crops is a matter still requiring study.

D. v. S.

169. Value of Lime and Inoculation for Alfalfa and Clover on Acid Soils.

GRAUL, E. J., and FRED, E. B. *Agricultural Experiment Station of the University of Wisconsin, Research Bulletin*, 54, pp. 1-22, figs. 4. Madison, Wisconsin, 1922.

The authors have demonstrated the value of lime and inoculation for alfalfa and clover on acid soils. Field Experiments were carried out on two types of soil, representative of a large area of Wisconsin silt loam, left without cropping for thirty years, and similar soil cropped regularly, and sand cropped for many years. The acidity was equivalent respectively to 1.04 gm. 0.86 gm. and 0.21 gm. of calcium carbonate, per 100 gm. of soil. In the earthenware jar tests, the soil was kept at about 50 to 60 % saturation with distilled water. The finely ground limestone contained about 60 % calcium carbonate and 40 % magnesium carbonate. The rate of application of potassium acid phosphate was 516 lb. per acre. The effect on the sand was marked, almost negligible on uncultivated silt loam, and slight cultivated silt loam. In the field experiments this application was omitted.

On the silt loam, inoculation would suffice to greatly increase the yield in the total amount of nitrogen. However, the combined treatment of inoculation and liming still further augmented the increase *e. g.* in the greenhouse, inoculation alone gave an increase of 15.6 % alfalfa (4 cuttings); and liming 40.2 %, and the combined treatment 49.7 % and an increased nitrogen content to 52.3 %. On uncropped soil the increase amounted to 70.3 % yield and 79.4 % nitrogen (3 cuttings). In the field experiments, the results were even more marked — the increase in alfalfa yield was 67.1 % after inoculation and 120.4 % with combined treatment (liming at the rate of 3 tons per acre). Still more marked increases were obtained when 8 tons of limestone were added. Nodule bacteria alone increased the nitrogen percentage (87.7 %) and adding limestone 160.2 %.

On sandy soil, calcium carbonate in addition to inoculation, resulted in an increase of 182.8 % and 319.7 % nitrogen (clover).

As a general rule, liming has proved more effective on dry land rather than on fertile soil, for example, on poor sandy soil the nitrogen increase for alfalfa was 87.5 lb. per acre for each of 5 cuttings, whilst on more fertile silt loam the increase was only 41.3 lb. Small applications of lime are advised; an excess is not only useless but occasionally has a deleterious effect, as is shown by the following typical example. On soil cropped with clover the amount of nitrogen per acre for one cutting was as under:

	lb.
Clover unlimed	100.2
" 1 ¼ tons calcium carbonate	140.0
" 2 ½ " " "	72.8
" 5 " " "	12.5

The amount to be used should be measured according to the proportion necessary for plant requirements. This corresponds to from 3-4 tons per acre on silt loams and to 2 tons on sands.

The use of calcium sulphate gave inferior results as regards crop yield, and calcium acetate gave the maximum yield and maximum amount of nitrogen when applied at the rate of one-half the full equivalent of calcium carbonate.

Observations indicate that plants obtain a certain percentage of nitrogen from the soil and the remainder from the air. L. V.

170. Situation of Nitrogenous Fertilisers in France.

MATIGNON CAMILLE, Rapport sur les engrais azotés. *Annales de la Science Agronomique*, Year XXXIX, No. 6, pp. 313-333. Paris, 1922.

This report, which was presented to the Interministerial Fertilisers Committee by M. CAMILLE MATIGNON on behalf of the Sub-commission of Nitrogenous Fertilisers, examines successively:

- 1) The amount of nitrogenous fertilisers required by France ;
- 2) How far France, as compared with Germany, has been re-stocked with agricultural nitrogenous substances ;
- 3) The productive capacity of the French nitrogenous fertiliser factories ;
- 4) Method of developing the nitrogenous fertiliser industry ;
- 5) The form in which combined nitrogen should be supplied for agriculture.

THE AMOUNT OF NITROGENOUS SUBSTANCES REQUIRED BY FRANCE.
— In 1913 France produced 75 500 tons of sulphate of ammonia ; she imported sulphate of ammonia, nitrate of soda, calcium cyanamide and calcium nitrate.

Nitrogenous substances used in 1913 expressed as nitrogen.

Sulphate of ammonia	96 000 tons
Nitrate of soda	320 000 "
Synthetic products	15 000 "
	431 000 tons

France thus required before the war, about 70 00 tons of combined nitrogen annually.

Pre-war nitrogen consumption of France as compared with that of Germany and of Belgium.

	Belgium	France	Germany
Nitrogen (nitrates, sulphates) used for fertilisers tons	20 000	70 000	210 000
Total area hectares	2 945 000	53 646 000	54 064 785
Productive area "	2 607 000	49 737 000	51 153 000
Arable land "	1 149 000	23 678 000	25 774 000
Under cereals "	809 000	13 587 005	14 647 000
Under wheat (in 1912) "	166 000	6 555 500	1 974 297
Wheat yield per hectare quintals	25	14	206

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Therefore, other things being equal, the nitrogen consumption of France was only about $\frac{1}{3}$ and $\frac{1}{5}$ of the amount used in Germany and Belgium respectively. The author is of opinion that the nitrogen placed at the disposal of the agriculturists should be trebled if the crops are to be increased to the required extent. This would bring the figure up to 200 000 tons, the minimum may be fixed at 140 000 tons.

During the agricultural year 1921-1922, France used 127 000 tons of sulphate of ammonia, and produced 52 000 tons. She imported 260 000 tons of nitrate of soda and manufactured some 12 000 tons of cyanamide for agricultural purposes. Expressed as nitrogen, the total consumption amounted to 69 000 tons which is very near the pre-war figure, and it is probable that a state of equilibrium has not yet been attained.

The price of nitrogen during the last agricultural year was 5-6 fr., viz., about four times higher than its pre-war price. Over 300 million fr. were paid for imported nitrogenous products during the agricultural year 1921-1922.

In 1913, Germany used 200 000 tons of nitrogen of which 60 % was imported. From 1921-1922, she used 290 000 tons all produced by her own factories. The output of the factories reached 500 000 tons by the end of 1922, hence she is now practically freed from all necessity to import Chili nitrate of soda and will soon be in a position to export nitrates herself. Had Germany not been developing the industry of synthetic nitrogenous products since 1914, she would have been obliged to expend 400 000 million gold marks to obtain their equivalent in Chili nitrate.

At the present time, there are in France, factories for the following nitrogenous products :

Sulphate of ammonia from gas and coke works, night-soil etc. In 1921, 51 400 tons were produced, as against 74 800 tons in 1913. It is hoped that the larger output will again be reached by 1924.

Cyanamide. The French cyanamide industry can now fix 20 000 tons of nitrogen, and will be able to fix nearly 30 000 as soon as the new factories are complete. *Synthetic nitrates*. The factories at present working turn out annually 1200 tons of nitrogen in the form of calcium nitrate.

The total annual nitrogen production of France amounts to 33 200 tons. As the minimum requirement is from 140 000 to 150 000 tons, there still remain 110 000 tons to be supplied by synthetic processes.

A bill was passed on June 22, 1920, authorising the establishment in the old Toulouse gunpowder factory of a Haber-Bosch plant capable of fixing 30 000 tons of nitrogen a year. According to the arrangement upon which the above bill was based, it was understood that the Bavarian Society should make over this process for the manufacture of urea and engage not to export any synthetic products to France for a period of 15 years. In the opinion of the author, the State should not grant a monopoly to the Toulouse factory, but should leave an open field for industrial competition which would be of great benefit to the agriculturist.

Attention should be directed chiefly to the manufacture of nitrosulphate and of urea. If necessary, a Compensation Fund might be constituted for the protection of the new nitrogen industries.

D. V. S.

*Agricultural Botany.***171. Distributional and Ecological Study of Mount Rainier, Washington.**

TAYLOR, W. P. (United States Biological Survey), *Ecology*, Vol. III, No. 3, pp. 214-237, figs. 4, bibliography. Brooklyn, N. Y., 1922.

Mount Rainier (above 10 000 ft. high) is composed almost wholly of basaltic rock built up from cinders, liquid lava etc., granite appearing in a few scattered places.

The author distinguishes between the *life zones*, limited in its distribution by temperature and height, and *habitats* characterised by difference in humidity, light, etc.; *associations* for groups of plants and animals of a particular *habitat*.

Four life zones are represented: — 1) *Transition zone*. This occurs chiefly in the south eastern area up to 3 000 ft.; 2) *Canadian zone*, wooded area between 2 000 and 4 500 to 5 000 ft.; 3) *Hudsonian zone* — 4 500 to 6 500 ft. — meadows and woods; 4) *Arctic-Alpine zone*, 6 500 ft. and over, above timber line. Two sub-zones are evident, the first with low rainfall and the second with abundant rainfall. The timber line is regulated by the snowfall.

The habitats are grouped according to 1) extreme moisture e.g. swamp; 2) moderate moisture e. g. forest; 3) deficient moisture e. g. pumice slope. The author has made a study of the flora and fauna associated with each group.

Between the south west and north east areas there is a very marked variation in moisture; for instance the prevailing direction of the wind in the first case is south-west, characterised by storms, but the north-east White River area is relatively arid. The flora and fauna is correspondingly varied, although certain species are found in both areas.

It has been found possible to classify tentatively many species; with the exception of the lower levels (Canadian and transition zones) it appears that species of the Hudsonian zone have come from the Hudsonian of the Cascade mountains to the east.

L. V.

172. Graminae on the Coast of the Red Sea as a Sand Binder.

A. C., *Revue Botanique appliquée et agriculture coloniale*, Year II, No. 14, pp. 584-585. Paris, 1922.

Description of *Odysea mucronata* Stapf (= *Festuca mucronata* Forsk = *Aclerus mucronatus* Defflers = *Triodia pungens* Roem and Sch.). This plant has stiff and pungent leaves and is found only on the coast of the Red Sea (Yemen, Hodeida), at Aden, on Perim Island, on the coast of British Somaliland, on Sokotra Island etc. The local Somaliland name is "*Affrug*", (mouth breaker) due to the pungency of the leaves. It cannot be used for fodder purposes, but is excellent as a sand binder owing

to its long trailing interwoven rhizomes. According to the author, the plant might well be introduced to bind the sand on desert coast areas where the vegetation is poor. Having regard to the distance it has travelled from whence it takes its generic name of *Odyssea*, the plant may be classified between *Diplachae* and *Eragrostis*. F. C.

173 **Research on the Physiological Signification of the Rubber contained in the Laticiferous Vessels of *Hevea Brasiliensis*.**

BOBILIOFF, W. Onderzoekingen over de physiologische beteekenis van caoutchouc woorkomende in de melksapvaten van *Hevea Brasiliensis* *Archief voor de Rubbercultuur*, Year VI, No 12, pp 465-493 Buitenzorg, December 1922

The author has investigated the formation of rubber in *Hevea* plants under different conditions and has carried out comparative experiments on the formation of rubber with and without light, and in the absence of reserve materials. By estimating the amount of rubber present at different periods, it is possible to draw some conclusions as to the part played by this substance in the metabolism of the plant. The author made comparative experiments between the groups of plants produced by given seeds, the condition of the individual as regards the nutritive matters present being ascertained by the starch and sugar content of the seedlings.

The rubber was estimated by means of the nitrosite method.

The exclusion of light resulted in an increase of the rubber in the seedlings, which proves that light is not necessary to rubber-formation, in fact darkness seemed to act as a stimulant increasing the rubber content.

Subsequently, the author studied the combined effect of darkness and removal of the seeds upon rubber formation. The removal of the reserve substances for the seeds also had a certain influence on the rubber secreted. The roots of the seedlings were found to contain rather less rubber than the aerial parts, but the difference is very small, and when the amount of rubber increases in the aerial parts, the percentage present in the roots increases in proportion.

When reserve substances are lacking owing to the removal of the seeds and to cultivation in the dark, the rubber is not used in the plants' metabolism, its percentage does not decrease, and in some cases, it has been found that the amount of rubber actually increases. Therefore the rubber in the laticiferous vessels should be regarded as a waste substance which is an intermediate, or final, product of definite physiological process of nutrition.

Under abnormal conditions, any disturbance of the plants metabolism is probably accompanied by a greater secretion of waste products and hence increases the rubber content.

Hevea latex contains a large amount of rubber and since the latter is of no use for the nutrition of the plant, the laticiferous vessels, as far as their function in respect to rubber is concerned, may be regarded as reservoirs of excreted substances.

D. V. S.

*Plant Breeding.*174. On the Histology of the *Triticum* Species.

NIKOLAEWA, A. Zur Cytologie der Triticumarter (Verhandlungen des Kongresses für Pflanzenzuchtun in Saratow 1920). *Zeitschrift für Induktive Abstammungs- und Vererbungslehre*, Vol. XXIX, Pt. 3, pp. 208-209. Berlin, 1922.

Histological research with reference to the genus *Triticum*, confirms the existence of a diversity of chromosomes amongst the various species. These may be subdivided as follows:—

Group I — with 14 chromosomes: *Triticum monococcum*.

Group II — 28 chromosomes: *T. durum*, — *T. polonicum*, *T. turgidum*, *T. dicoccum*.

Group III — with 42-44 chromosomes: *T. vulgare* 42-44, *T. spelta* 44, *T. compactum*, as many as 50.

Triticum fuliginosum possesses 44 chromosomes and belongs to the *T. vulgare* group. One type of this wheat studied by VAVILOV and specified as *T. fuliginosum* var. *persicum* presents several aberrant characteristics which suggest distinctly the *T. durum* group. Histological observations remove any doubts formerly held by the author as regards the systematic classification of *T. fuliginosum* var. *persicum* and indicate the presence of 28 chromosomes possessing numerous characteristics of Group II. On account of these results this variety has been renamed *T. persicum* Vavilov, and is no longer classified under the *T. vulgare* group.

Classification is largely based on study of the parents (inheritance etc.) followed by distinction between natural characteristics.

In the present case a fourth method is evolved viz., the histological study which adds to the other three methods a careful study of the genetical constitution of the *Triticum* species; crossing (TSCHERMAK); serum (ZADE) and immunity (VAVILOV).

The results obtained by means of the four methods agree will together.

	TSCHERMAK	ZADE	VAVILOV	Number of chromosomes
I.	<i>T. monococcum</i>	<i>T. monococcum</i>	<i>T. monococcum</i>	14
II.	<i>T. durum</i>	<i>T. durum</i>	<i>T. durum</i>	28
	<i>T. turgidum</i>	<i>T. turgidum</i>	<i>T. turgidum</i>	28
	<i>T. polonicum</i>	<i>T. polonicum</i>	<i>T. polonicum</i>	28
	<i>T. dicoccum</i>	<i>T. dicoccum</i>	<i>T. dicoccum</i>	28
III.	<i>T. vulgare</i>	<i>T. vulgare</i>	<i>T. vulgare</i>	42-44
	<i>T. spelta</i>	<i>T. spelta</i>	<i>T. spelta</i>	44
	<i>T. compactum</i>	<i>T. compactum</i>	<i>T. compactum</i>	50

G. A.

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175. Characteristics of Wheats of Bihar and Orissa (India) and Comparative Rust Resistance.

HOWARD, A, HOWARD, G L C, and KHAN, A R (Imperial Economic Botanists) *Memoirs of the Department of Agriculture in India, Botanic Series*, Vol XII, No 1, pp 1-20 Calcutta, — London, 1922

The present paper deals with 122 of the various agricultural type of common wheats belonging to 12 botanical varieties found in the most important wheat growing tracts of Bihar (India), north and south of the Ganges This systematic classification is of undoubted value to the plant breeder and mycologist

Careful records have been kept as to degree of susceptibility to the three common rusts Although none of the types are likely to prove of use for distribution to cultivators on account of their weak vegetative characters and their inability to respond successfully to intensive cultivation, they should, however, be of distinct use in plant breeding in providing early maturing parents with great resistance to rust, combined with short straw and superior grain qualities The celebrated "Marquis" wheat was obtained by crossing Red Fife with one of such wheats found in Hard Red Calcutta

With regard to the various types the following particulars are of importance —

Susceptible to Rust	Rust Resistant	Strong Straw
Var <i>albidum</i> Al » <i>alborubrum</i> Keke intermediate and late » <i>erythroleucon</i> Keke » <i>erythrospermum</i> Keke v early » <i>ferrugineum</i> Al » <i>ferrugineum</i> Al <i>gracum</i> Keke early and intermediate » <i>lutescens</i> Al » <i>meridionale</i> Keke » <i>miturum</i> Al	Var <i>alborubrum</i> early No 6 » <i>bengalensi</i> all » <i>erythroleucon</i> intermediate No 61 » <i>erythrospermum</i> v early, No 30 several early Vars. late, especially, No 52 v late Nos 53, 55. especially No 57 » <i>gracum</i> intermediate No 19 late Nos 27, 28, 29 » <i>indicum</i> all, especially 109 » <i>nigricans</i> nearly all, especially 87, 89, 94, 95, 98	Var <i>bengalensis</i> v early, Nos 110, 114 » <i>erythroleucon</i> early, No 59 intermediate Nos 61, 62, 63, 67 late Nos 68, 69 » <i>erythrospermum</i> late Nos 46, 47, 49, 51, 52 v late Nos 55, 57 » <i>ferrugineum</i> intermediate Nos 75, 76 » <i>indicum</i> Nos 102, 10, 109 » <i>nigricans</i> early, Nos 87, 89 intermediate Nos 93 94 v late, 94, 95, 96, 99, 100

* Apart from these the straw is generally weak

The wheats are almost all bearded, with smooth chaff and short rounded grains, frequent occurrence of black awns, and the wheats are readily distinguished from the types met with in the United Provinces and the Punjab.

The close observation for some years of types which appear to be more rust resistant than the average is of evident value, taking into account the variations which are liable to occur from year to year owing to external factors, seasonal differences, etc. M. L. Y.

176. The Genetic Composition of a Speltoid Mutation of Wheat.

LINDHARD E. Zur Genetik des Weizens — Eine Untersuchung über die Nachkommenschaft eines in Kolbenweizen aufgetretenen Speltoid-mutanten. *Hereditas*, Vol. III, Part I, pp 1-90, fig. 10. Lund, 1922.

In some new lines of *Triticum vulgare*, there appear occasionally mutations with a peculiar genetic constitution which are called "speltoids" by NILSSON-EHLE on account of their resemblance to *Triticum Spelta*.

A pure line of autumn wheat, Kolben (of the square head type) suddenly produced, in 1914, one of these heterozygous forms with progeny consisting of both normal and speltoid individuals. In order to study the segregation phenomena and learn more of the genetic constitution of this hybrid, some 100 000 plants belonging to seven successive generations were examined, all the types which differed in any way from the original heterozygous individual being carefully reproduced and propagated.

In 1919, some reciprocal crosses were made, and in 1921, the resulting F_2 generation was examined.

The types in question (which may be either awned or awnless) were as follows: normal type, homozygous speltoid, heterozygous speltoid; heterozygous compact type; heterozygous square-head type; ordinary dwarf wheat; an ordinary very late wheat ripening four weeks after the others; and a perennial type that very seldom produced any ears.

On crossing the normal type NN with the speltoid heterozygous form Sp N, different results were obtained according to whether the speltoid mutation was the paternal, or maternal parent.

Thus, from $\text{♀ NN} \times \text{♂ Sp N}$, offspring only of normal type were obtained (♀ because in the speltoid form the ♂ gametes of normal type are eliminated), and from the $\text{♀ Sp N} \times \text{♂ NN}$ both normal and speltoid hybrids resulted in about the same proportions as in the case of the self-fertilisation of the speltoid form.

The production of zygotes in this heterozygous speltoid type as a result of autofertilisation may be expressed as follows:

$$\text{♀ } (1 \text{ N} + n \text{ Sp}) \times \text{♂ } (\text{N}) : n \text{ Sp N.}$$

where n in the different speltoid types has the value of 1-4 (5-7) or 8.

The genetic factor of awns is linked to the speltoid complex in such a manner that the speltoid awnless form must be heterozygous both as regards the character of the mutation and the awn factor. The author

assumes the existence of a determinant u that causes the development of the awn, and of which the action is suppressed in the presence of the inhibitory factor U . Therefore u = awned and U = awnless.

The heterozygous, awnless, speltoid form should also be heterozygous as regards the awn $\left(\begin{smallmatrix} \text{♀} & \text{♂} \\ u & U \end{smallmatrix} \right)$; but the complete elimination of the speltoid gamete prevents the u factor being carried by the pollen. And since the linkage between the gene u and the gene Sp is very strong, in the same way the two factors N and U will tend to remain together, so that the heterozygous speltoid of the composition $u U$ will frequently have progeny in which the normal plants cannot fail to be awnless with the formula : $U U \text{♀} (1 U N + n u Sp) \times \text{♂} (U N) : n Sp U N$.

This linkage is so strong that only 4 out of 21 340 plants of the speltoid form were awned

In the course of the work very interesting cases of the phenomenon called heterogamy by DE VRIES, were observed.

If Sp stand for the mutant of the speltoid type and N for the determinant of the normal squarehead type, we shall have $Sp N$ as the formula for the heterozygous individual. An investigation of the data relating to the segregation of this hybrid shows the complete elimination of the speltoid gamete.

If we take the most simple case with the ratio of 1 normal : 1 heterozygous speltoid, as represented in the following scheme :

Diagram I

	♀		
♂		N	Sp
1 N		1	1
0 Sp		0	0

Sp is completely eliminated. In other cases, where the number of the speltoid, heterozygous individuals exceed that of the normal individuals, not only are the gametes from the ♂ side eliminated, but those from the ♀ side are re-duplicated. Expressing by n the occasions when the female gametes with the character of Sp exceed the cells with the N character, we obtain the following scheme.

Diagram II

♂ \ ♀	♀	1 N	n Sp
	♂	1 N	n
1 N		1	n
o Sp		O	O

From the material collected, it has been found that n generally has the following values: 4 (5-7?) and 8.

All cases of the partial elimination of the gametes can be reduced to the following four schemes.

Diagram III

♂ \ ♀	♀	1 N	8 Sp
	♂	1 N	8
1 N		1	8
1 Sp		1	8

= 1 normal: 9 heterozygous speltoid, 8 homozygous speltoid.

Diagram IV

♂ \ ♀	♀	1 N	1 Sp
	♂	1 N	1
8 N		8	8
1 Sp		1	1

= 8 normal, 6 heterozygous speltoid, 1 homozygous speltoid.

Diagram V

♂ \ ♀	♀	1 N	8 Sp
	♂	1 N	8
4 N		4	32
1 Sp		1	8

= 4 normal, 33 heterozygous speltoid, 8 homozygous speltoid.

Diagram VI

♂ \ ♀	♀	1 N	4 Sp
	♂	1 N	4
8 N		8	32
1 Sp		1	4

= 8 normal, 33 heterozygous speltoid, 4 homozygous, 4 homozygous speltoid.

The author also gives the results of the genetic analysis of the types *compactum*, heterozygous Squarehead etc. which, as has been already said, occur in larger, or smaller numbers in the progeny of the heterozygous speltoid form. On the other hand, in the offspring of the Normal type, 28 individuals are heterozygous speltoid, and 9 *compactum* out of a total of 14 288 individuals. The question may now be asked whether this is a case of the appearance of new factors, or merely of fresh grouping.

Even if we adhere to the conception of the linear distribution of the chromosome genes, considerable differences may be observed. In the sub-species of cultivated wheat, the haploid number of chromosomes may be expressed by $x = na$, and according to KAHARA, in the case of *Triticum monococcum* $x = 7$; in *T. dicoccum* and others $x = 2 \times 7$; in *T. vulgare*, *T. spelta* and *T. compactum* $x = 3 \times 7$. The chromosomes show great stability also in the genes they contain. It may, however, be reasonably assumed that in species with $x = na$ chromosomes, true polymery may arise, in so far that an n number of chromosomes may contain identical genes. If in addition, the chromosomes occasionally change their positions in the formation of the pair, or twins, so that for instance, chromosome N 1 ♀ unites with chromosome N 2 ♂ and vice versa, the result would be the formation of a structure of heterozygous character as regards the two chromosomes composing it, and a series of complex mutations would arise.

It is not impossible for a normal and apparently homozygous type to be a heterozygous complex fixed by almost complete heterogamy.

Whenever the productivity, vigour, and self-fertility of the varieties of cultivated wheat are really due, at least in part, to the heterosis inherent in the nature of a heterozygous individual, it is possible to attribute to the same class of phenomena the fact that the heterozygous, speltoid individual, in which heterogamy has been partly destroyed by mutation not only shows different segregation schemes, leading to the formation of numerous distinct types, but also produces offspring varying considerably in the characters influenced by heterogamy: fertility, vigour etc.

G. A.

177. Reciprocal Crosses of Rye and Wheat.

GAINES E. F. and STEVENSON F. Rye-Wheat and Wheat-Rye Hybrids. *The Journal of Heredity*, Vol. XIII, No. 2, pp. 81-90, figs. 2. Washington, 1922.

The authors have succeeded, after seven years work at the Washington Agricultural Experiment Station, and in the face of much difficulty, in obtaining wheat \times rye and rye \times wheat hybrids.

This is the first time that it has been possible to use as rye the female parent.

RYE \times WHEAT. — "Rosen", a Russian variety of rye was fertilised with the pollen of four varieties of wheat: Fortyfold, Jenkin, Jones Fife and Hybrid 128. The percentage of seed set was relatively high, but very little grain developed in the individuals of the F_1 . These hybrids had

the habit of rye, although their mode of growth was slightly modified by the influence of the wheat parent.

The sterility percentage in Rosen \times Jenkin was 95; Rosen \times Jones Fife, proved a little more fertile, while the percentage of sterility in Rosen \times Hybrid 128 varied according to the individual from 75 to 90. The degree of fertility was the most variable character in the F_2 , and ranged from complete sterility to complete fertility with an average of 50 %.

The F_2 hybrids showed a decided morphological resemblance to rye, for they were all awned, although in every case the wheat parent belonged to an awnless variety.

The length of the culms and ears was intermediate; 90 % of the F_2 Rosen \times Jones had purple straw, although the straw of both parents was white

WHEAT \times RYE. — Turkey \times Rosen. In the F_1 generation were obtained 2 individuals very similar to wheat in appearance, but which revealed their hybrid character by their high degree of sterility. One plant bore 26 completely sterile ears and 6 that were partially sterile, while the other produced 13 sterile and 10 partly sterile ears.

The characters of the F_2 hybrids point to a redistribution of the chromatin during the process of re-combination. Fifteen of these hybrids were awnless, although both the parents were awned, this can only be explained by supposing that the chromosome containing the gene for the formation of the awn had been eliminated during maturation.

In every case, the hybrids resulting from the crosses rye \times wheat and wheat \times rye are matroclinous and reproduce the morphological type of the female parent.

G. A.

178 How to obtain Types of Maize with High Gluten Content (1).

HAYES, H. K. Production of High Protein Maize by Mendelian Methods *Genetics*, No. 7, part 3, pp. 237-257. figs. 5. Menasha (Wiscon.) May 1922.

The character of "high protein content" behaves as a recessive, and if it is wished to isolate lines of maize with grain rich in gluten, it is necessary to have recourse to self-fertilisation and then to discover by means of the analyses of the progeny in which lines this character has become fixed.

The author has succeeded in isolating by this means numerous lines of Minnesota No. 13 that are distinguished by the high protein content of their grain.

In 1916, he made some very successful attempts to produce synthetically new valuable types by crossing the above-mentioned lines, or stocks, which were rich in gluten.

	Weight of grain per stem in gm.	Protein %
Minnesota No. 13	122.6	12.01
Synthetic types	122.6	14.99

(1) See R. 613, 1921 (Ed.)

In 1920, a double cross was carried out between four lines rich in protein substances.

Leaming High Protein \times Illinois *h. p.* \times Minnesota No. 13 \times M. No. 13.

	Weight of grain per stem in gm	Protein %
Double cross	128.2	14.92
(Reciprocal)	141.9	15.14
Minnesota No. 13	144.9	12.37

From these experiments it seems possible to isolate, by self-fertilisation, lines of maize with a high gluten content and to intensify this character by crossing the products thus obtained G. A.

179. The Genetic Composition of some Abnormal Forms of Maize.

EMERSON, R. A., and EMERSON H. STERLING (Genetic Interrelations of Two Andromonoecious Types of Maize, Dwarf and Anther-Ear) *Genetics*, No. 7, part 3, pp. 203-236 Menasha, 1922.

In this article a description is given of two types of maize, dwarf and anther-ear, that are characterised by the presence of stamens in the female inflorescences, these male organs being usually well-developed, although in some lines, they have remained almost rudimentary. These abnormal types have short internodes and wide, rather short, laminae; the male inflorescences are vigorous and relatively little branched; the ears are short and thick, and frequently prolonged by an unbranched process resembling the male inflorescence.

As these distinctive characters were variable, it appeared at first to be a question of a single type, but the hybrids resulting from crossing two dwarf individuals and two with anthered ears were all normal which proved the different genetic composition of the two types under discussion.

Further research has shown both of them to be distinguished from the normal by a single recessive character. dwarf *dd* (normal *DD*) anthered ear *an an* (normal *An An*).

By crossing a normal plant with an abnormal, an F_2 is obtained consisting of normal and abnormal plants in the proportion of 3 : 1.

From other crosses were even obtained some individuals having the double recessive character. *dd an an* G. A.

180. Genetic Factors Affecting the Colour of the Testa of the Poppy.

MARTIN LEAKE, H. and RAM PERSHAD, B. The Coloration of the Testa of the Poppy Seed (*Papaver somniferum*). *Journal of Genetics*, Vol. 12, No. 3, pp. 247-249 Cambridge, 1922.

The colour of the testa in *Papaver somniferum* L. depends upon three factors. S = straw-coloured; P = pink; B = blue. In the absence of P and of B, the homozygous type SS is distinguished from the heterozygous by the greater intensity of the tint.

In the absence of S and of B, there is no means of distinguishing the homozygous PP from the heterozygous Pp.

The factors S and B are linked; this is the only [case of linkage hitherto observed in *Papaver somniferum*. G. A.

181. The Chief Crops of Poland from the Standpoint of Seed Production.

Communicated by M. B. JANISZOWSKI, Consul General, Delegate of Poland at the International Institute of Agriculture.

Seed production is much developed in Poland. The crops of most importance from this point of view are, in the first instance, cereals and secondly, potatoes.

1) WHEAT. — On account of its climate, Poland is able to produce varieties of wheat which are not only very productive, but also hardy enough to resist extreme cold. It is probable that in the future, this country will supply Eastern Europe with improved types of wheat. Polish wheat is intermediate between the starchy wheats of Western Europe and the hard wheats with flinty fracture produced in Russia. In order to give some idea of the amount of seed-wheat furnished by Poland, mention is made of some of the varieties grown.

District of Chiechanow Sandomiers, Pulvry, Tulawera, Plocka, and Chruszów w wheats

Podolia Galician Ostka wheat with red kernels derived from a large grained Hungarian type (Banatka).

At *Dublany* Modifications of Square Head \times Galician Ostka.

At *Kutno* Square Head \times Renodland

Near *Cracow* Wanda and Sandomierz wheats

At *Sobieszów* Pleck, Wysoka, and Triumph Skrzessowicz (department of Kielce), modification of the variety Konstancja, itself derived from Eppweizen, or New Jersey.

Upper Lithuania local type.

Former Prussian Poland M. HILDEBRANDT grows "Pinz Hatzfeld" and "Dickkopf" at Kleszczow M. STIEGLER grows "No. 22" and "Zeppelin" at Sobòtki; M. MÜLLER grows "Eppweizen" at Kilnow; M. BENSING grows "Trotzkopf" and Oslanin,

During the war, wheat selection Stations were founded at Lyszkowice by the Granum Joint Stock Co., at Szezeplin by the firm of W. MEYSEL, at Kwasów by the Udyez Joint Stock Co., at Oltarzów by the Polish Society for the Cultivation of Wheat and Potatoes; at Czestaje by the Sandomierz Society for Seed Propagation; at Wierzbno by Dr. SZANKOWSKI; at Kawenczyn by M. OLEŃSKI etc.

In Lesser Poland, there is a Station belonging to the Joint Stock Co. Udyez and another that is the property of M. R. SĘPIO.

In Pomerania, the Chamber of Agriculture has begun improvement work.

In Greater Poland similar efforts are being made at Sierkierki and in the establishment of the "Siew" Society. It should be noted that up to the present time, Poland has practically succeeded in growing all her own seed-corn, for the small quantities imported from France, Sweden and Germany invariably proved a failure and should not be taken into consideration. Poland can also produce wheats suitable for Russia. The varieties "Banatka", "Zlotka", "Hanka", "Sandomierks", "Ostka", "Mikulicka" and Udyczanka will probably do well in the South-West, while the wheats of Upper Lithuania, Plock, Sobieszyn and Danków are suited to the conditions obtaining in the North-West.

2) RYE. — Twenty years ago, Petkus rye was of paramount importance to Polish agriculture, as it was the only improved variety. Its selection was carried out at Dublany, Hawenczyn, Oltarzów, Pistow and Wierzbin. Petkus is still a prime favourite as is also the von Lochof variety, but these are now Polish types which are more productive naturally better adapted to the local conditions. Before the war, local varieties of rye entered into competition with German ryes. The best cultivated land was sown with A. OLENDZSKI's Kawenczyn variety, while for the poor soils the Sobieszyn Experiment Station had provided a "peasants' selected rye" largely grown in Ruthenia not only on account of its grain, but also for its straw which was used for thatching. In Poland, early Mikulicze rye was grown and in Lesser Poland Turnau rye; at Piastow J. OLENDZSKI's Hanne rye, in Greater Poland, the Zealand rye cultivated by HILDEBRANDT, in Pomerania, the Gwizdzyń rye cultivated by HORDOW and Dr. SZANKOWSKI's Wierzbin rye.

Dankow rye had been selected for very rich soils, and Kawenczyn for ordinary soils, both are resistant to rust and cold, so if the varieties Petkus and von Lochoff are still popular, this must be attributed to the conservatism of the Polish agriculturist and to his ignorance of home products.

Since the war, several new Stations have been established where rye improvement is being carried on: at Mosniki (near Radom) by the Polish Society for Wheat and Potato Growing (Oltarzew), by the Zerków Society (Greater Poland), and the Tdycz and Siew Societies (Greater Poland). The Pulawy Agricultural Institute is engaged in the selection of both rye and wheat.

The Polish ryes, Danków, Kawenczyn, Kazymierz, Sobieszyn, Wierzbin and Weznice do well in the South-West of Russia, to which country they will be exported in future.

Poland has almost reached her pre-War wheat and rye production which amounted to: 56 592 700 quintals of rye and 17 786 400 quintals of wheat. In 1921-1922, 51 284 190 quintals of rye and 12 135 240 quintals of wheat were produced, or a total of 63 389 430 quintals of grain. If from this amount are deducted the 10 481 200 quintals used for seed, and the 44 118 100 quintals required for local consumption, there remain 8 790 130 quintals for export.

3) BARLEY. — Barley cultivation before the War was of little importance in Poland. At Chruszczów a malting barley called "Kemp-

ski," "Kobylnicki," and "Nadwislanski," and a four-rowed variety used to be grown. At Dublany and at Sobieszyn, the "Nadwislanski" barley (from the Vistula) was grown. "Hanna" was the sole variety cultivated at Strzykuly and Oltarzow, whereas at Kutno, modifications of the local varieties, "Gryf" and "Kobylnicki" were in favour. As soon as the war was over, however, barley cultivation began to increase. Prof. STANISZKIS, of the Kutno Experiment Station, has obtained a new form by selection from the local type.

Barley-growing in Poland has a great future, as the soil and climate are very suitable and malting-barley is in great request in Russia, where none can be produced owing to the poor soil and rigorous climate.

The variety of Hanna cultivated in Poland, and also the 2-rowed and 4-rowed barleys of Kutno and the Vistula, are used largely for seed-corn in West and South-West Russia. The 1921-1922 crop reached 13 697 300 quintals; of this, 2 004 700 quintals were reserved for seed and 10 234 800 quintals were consumed locally, thus leaving 1 467 800 quintals available for export.

4) OATS. — Previous to the war, the selection of the numerous native types of oat was chiefly carried out at Dublany. At Łeki (Kutno district) mass selection of the Swedish "Teodosia" variety was practised, while a very early oat from Niemiercz was cultivated at Piassow (Department of Radom). At Sobieszyn, the early variety "Rychlik Lubelski" was grown and also "Zimak" and "Marczak".

The oats generally used for seed in Poland are obtained by growing Svalöf varieties (Vainqueur, Pluie d'or) and German varieties (Zolty, De Lechow, De Leltewice). Dr. NIELSEN-EHRLE, the originator of the Svalöf oats, is of opinion that the varieties Le Vainqueur and Pluie d'Or cannot be improved further from the standpoint of yield, hence any work in this direction would only prove lost labour.

Since the end of the war, selection work has been continued at Dublany, Łeki and Sobieszyn, as well as at Kawenczyn, where the parents of the Sobieszyn variety are being studied, and at Kwasow, where Finnish oats and early Ukranian oats are being crossed with the Szatillöv. oat.

The best oats for South-West Russia would be the early "Kanar" variety from Niemierzczyn and those raised from seed obtained from Swedish varieties cultivated in Russia; in the other parts of the country, Sobieszyn oats, "Teodosia" and modifications of the Swedish varieties "Pluie d'Or" and "Vainqueur" would all do very well.

5) Potatoes. — The systematic selection of potatoes has reached a very advanced stage in Poland. At Calowanie, M. K. DREHWITZ is working on the "Silésie" variety; at Danków, the "Wohltmann" variety is being selected and at Oltarzów, the "Nouveaux Américains". The "Nowa Wies" potato grown on the estate of N. DOŁKOWSKI is well known, while, in former Prussian Poland, RICHTER and MODROW are engaged in selection. Other societies have been formed since the conclusion of the war at Siekierki (Greater Poland) (Granum Society), and at Zerkow (Udycz Society); potato-selection is also being undertaken by the "Siew" Society, as well as at Przeworsk by the Udycz Society.

The largest quantity of potatoes exported for food and seed go to France, Denmark, Holland, Switzerland, Belgium, Germany and Rumania. Before long, Polish potatoes will doubtless be sold in Russia. The 1922-1923 crop will probably leave 600 000 tons available for export.

6) FORAGE CROPS. — Before the war, the seeds of meadow plants formed one of the chief articles of export from of Russian Poland and Galicia. The Vetch and lupin seeds were mostly produced in the west of former Russian Poland and in Posen; crimson clover seed came from Volhynia in the Department of Kielce and from the north of the Department of Warsaw. Polish crimson clover is of excellent quality being resistant to cold and drought, indeed, in the latter respect it is even superior to American clover. The annual exportation in the future to Great Britain, Holland, Denmark, Sweden and Russia may be estimated at 15 000 to 25 000 quintals. The largest amount will go to Russia, for on account of the short growing season, clover seed never ripens in that country.

Sainfoin is especially cultivated in the Departments of Kielce and Cracow. Other forage plants grown in Poland are white clover, alsike clover, crimson clover, and lucerne. Several thousands of quintals are exported annually. The farms producing meadow gramineae are concentrated in Lesser Poland and the Carpathians.

7) BEETS. — From the standpoint of seed-production the beetroot ranks first among all the other plants of Poland. The principal beet-growing Stations are at Gorka Narodowa, and Wicławice (J. BUSZZYNSKI), Opatów district, Sozcgeln (A. JANASG estate) Lyzykowice (Granum Society), Department of Kielce; Kwasów (MDVCZ UDVCZ), Department of Kielce, Oltarzew (firm of Z RYX), near Warsaw, Kruków and Kurza Góra, near Sandonierz, Motycz (Greater Poland Society for Seed Propagation) near Lubin. In former Russian Poland and former Prussian Poland there are other less important establishments, most of which belong to the sugar-factories. The Młodzieszyn refinery is well-known, as it was the first factory in Russian Poland to practise beet selection based upon the specific gravity of the roots. This method was afterwards adopted by the sugar-factories of Hermanów, Sanniki and Orzyszów. Many cultural experiments are also made for the purpose of determining the varieties of beet best suited to the conditions of the soil and climate. In this connection may be mentioned the work of the Warsaw Sugar Manufacturers' Association and that of the Society of the Practical Sugar Manufacturers of former Russian Poland. These experiments have shown the Polish beets to be in no way inferior to foreign beets, which they often excel in growth vigour. The pre-war brisk trade in Polish beet-seed which was exported to Belgium, France, Spain, Italy, Germany and America has now revived. Owing to the combined efforts of the Government and producers the value of the seed continues to increase.

8) OLEIFEROUS PLANTS. — Previous to the war, Poland had a large export trade in oleaginous products, especially in rape and poppies; former Russian Poland used to export about 10 000 tons annually. Several hundred tons of poppies were sent annually to America. Before

the war Poland was obliged to depend on Germany as an intermediary in her overseas transactions, whereas, she is now able to dispense with this costly assistance.

9) **TEXTILE PLANTS.** — The two chief textile plants cultivated in Poland are flax and hemp; their fibre is of inferior quality to that of similar plants growing in Western Europe. The flax is usually pulled before it is completely mature which allows both the seeds and the fibre to be harvested, but is very detrimental to the quality of the fibre. Polish flax is not suitable for making fine fabrics, and is generally used mixed. At present, Poland is without any organisation for directing the production of the seeds of oleiferous and textile plants.

10) **GENERAL ORGANISATION.** — Poland has, on the whole, made great progress in the organisation of its agricultural services. There is no lack of experts and the Polish agriculturist compares well with the farmer of any other country. With a view to the co-ordination of the several organisations for seed propagation they have all been united in a Central Section for Seed Propagation, which is itself affiliated to the General Section of the Central Association of Agricultural Societies. This Central Section includes the following organisations: the Sowing Section of the Central Agricultural Society, the Chamber of Agriculture of Greater Poland, the Chamber of Agriculture of Pomerania, the Sowing Section of the Lwow Farmers' Society and the Society of Polish Cultivators and Seed Producers. The Agricultural Society of Lesser Poland takes no part in the work of the Central Section.

11) **THE FUTURE OF AGRICULTURE IN POLAND.** — Now that Poland has regained her independence, the conditions of agriculture in the country are such as to encourage her to hope that a prosperous future awaits this important industry.

The Great War has, however, disturbed the economic life of Europe, and it will be long before the balance between production and consumption can again be restored. The economic ruin of Russia, a country formerly exporting large quantities of wheat and of meat, has opened important markets for Polish agricultural products, of which Poland will soon be able to take full advantage, for far from being dependent on foreign imports she will have, from the current year, a considerable surplus stock for export after all her home requirements have been satisfied.

In addition to exporting food products, Poland relies on developing a foreign seed trade, for as regards climate, she is intermediate between Western and Eastern Europe and therefore many Western varieties that would perish, or rapidly degenerate, if directly transported to the colder regions further East, do very well if they are first cultivated in Poland where they adapt themselves to the new conditions without losing their valuable qualities. Before the war, there were Polish Experiment Stations directed by Poles at Podolia and Ukraina, in Russia, where the different varieties suitable for these cold climates were systematically studied. As the present internal conditions of Russia prevent scientific work being carried out there any longer, these Stations have

beeh removed to Poland, where the work has been taken over by special firms (Udycz and Granum).

Poland is therefore thoroughly equipped for developing her seed trade with Russia which country should also become an excellent market for Polish agricultural produce.

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D. v S

183. JOHNSON, E S (Agricultural Experiment Station University of Maryland College Park, M D) Moisture Content of Peach Buds in relation to Temperature Evaluations *The Botanical Gazette*, Vol LXXIV, No 3, pp 314-319, figs 2 London

The author investigated the relation between the water content of peach buds and the influence of meteorological factors. He discovered a definite correlation with the temperature: the percentage of water increases with the temperature; the ratio may be expressed in graph form by straight line.
L V

- 184 PATERNO, E Preparazione dei sali potassici dalla leucite e da altri silicati potassici (Preparation of Potassium Salts from Leucite and other Potassium Silicates) *Giornale di chimica industriale ed applicata*, Year V, No 1, p 14 Milan, 1923

Description of the preparation of potassium salts from leucite and other potassium silicates, by means of a solution of sodium chloride.
D. v. S.

185. COLIN, H and BELVAL, H, La genèse des hydrates de carbone dans le blé; présence de lévulosanes dans la tige (Origin of Carbohydrates in Wheat, and Levulose Content in the Stem) — *Comptes rendus de l'Académie des Sciences*, Vol 175 No 26, pp 1441-1443. Paris, 1922

The composition of the wheat leaves and the stem in the absence of ears consists largely of saccharose and products of hydrolysis. After the month of June the levulose percentage increases. Hydrolysis results in a large proportion of fructose.
D. v S.

- 186 HARLAND, G C Inheritance in *Ricinus communis* L. *Journal of Genetics*, Vol. 12, No 3, pp. 251-255 Cambridge, 1922.

The two characters B (bloom) which determines the waxy covering of the vegetative organs, and M (mahogany) producing the mahogany red of the castor-oil plant are linked and give a crossing-over percentage of 8.3
G. A

CROPS OF TEMPERATE AND TROPICAL COUNTRIES

(INCLUDING FORESTRY)

SYNTHETIC ARTICLES.

187. Value of the Efwatakala Grass (*Melinis minutiflora*) as a Fodder and in the Control of the Tsetse Fly (1).

I. — Royal Botanic Gardens, Kew, *Bulletin of Miscellaneous Information*, No. 10, pp 305-316, plates 2, figs 12. London, 1922.

II. — *Bulletin of the Imperial Institute*, Vol XX, No 3, pp. 300-302. London, 1922

III. — SAMPLER, F. C Pasto "Gordura" *Revista Nacional de Agricultura*, Year XVI, Series XVII, Nos 213, 214, pp 263-265 Bogota, 1922.

IV — M. G C Un zacate que evita enfermedades el capim gordura (*Melinis minutiflora*) *Boletín de la Cámara de Agricultura de Costa Rica*. Year II, No 7, pp. 329-330. San José, Costa Rica, 1922.

I. — During a recent tour in Angola (Portuguese West Africa), M. T. DAWE reported a grass apparently much sought after by animals and at the same time distasteful to the tsetse fly which has been the cause of severe losses in Africa and elsewhere. This grass identified as *Melinis minutiflora* f. *inermis* Beauv. has been found widely distributed in the Portuguese Congo, both on the plains and at 2500 to 3000 ft. altitude. In Angola it is stated to serve as an excellent pasture from October to the end of May, and remains green even during the dry season.

With reference to the tsetse fly problem, DAWE draws attention to the remarkable value of this plant for converting fly infested areas into cattle raising lands of the first importance. The same applies to horse-breeding and the consequent facilities as regards transport and similar problems. The strong odour of the viscid drops of oil exuded by the hairs on the leaf-sheaths, combined with the « fly catcher » adaptation are properties evidently objectionable to the tsetse fly.

A rotation of maize, cotton, beans or groundnuts and efwatakala grass is recommended; isolated trees and palms need not be cleared, but the grass may be sown round them.

Experiments have been made in Uganda to compare the efwatakala and the citronella grasses; the latter possesses aromatic and oily properties noticeable only when the leaves are bruised; hence the advantages attached to *M. minutiflora*.

It is interesting to note that the natives have already shown their knowledge of the insecticidal and preventive properties of this plant. It has been used to make nests for sitting fowls and as a bedding for dogs when about to give birth to young, as it prevents both fowls and dogs from being attacked by fleas. The fresh grass has been used for cleaning clothes made from raphia fibre.

(1) See R. 1921, Nos 816 and 1078. (Ed)

A description is given of the examination made at the Herbarium, Kew Gardens; the origin, history, distribution and structure of the plant etc. The oil-containing hairs have been carefully examined and the oil analysed by T. A. HENRY at the Wellcome Chemical Research Laboratories. The results may be summarised as follows. The fresh plant yields about 0.001 % of volatile oil which consists largely of free acids and esters with possibly some phenolic substance. The characteristic odour of the plant, similar to that of cumin, cannot be attributed to an acid ester or phenol since it persists after these constituents have been removed or decomposed.

The feeding value of *M. minutifolia* has been reported favourably in Brazil, Columbia, Hawaii, Southern Rhodesia, Queensland and New South Wales.

II. — The grass has been examined recently at the Imperial Institute, London and an analysis gave the following results, which are shown in comparison with millet hay, timothy grass hay, and elephant grass (of 8 week's growth).

	Ewetakala grass	Millet	Timothy	Elephant grass
	%	%	%	%
Moisture	7.7	13.4	14.3	8.0
Crude protein . .	5.7	10.8	6.5	7.1
Oil	1.9	2.2	2.4	1.0
Fibre	33.6	29.4	28.5	31.0
Carbohydrates (by difference).	* 43.8	38.5	41.1	38.7
Ash	7.3	5.7	5.2	14.2
Food units	63	71	68	57
Nutrient ratio	1.85	1.4	1.55	1.58

* Including 1.1 % reducing sugars, calculated as dextrose

The volatile oil had evidently been lost on drying.

According to the reports from Brazil this grass shows an extraordinary adaptability to soils deprived of its natural vegetation, and this is no doubt applicable elsewhere. In connection with this possibility STAFF at Kew draws attention to two other species of *Melinis* worthy of notice viz. 1) *M. effusa* Stapf (at present only recorded from Angola and the Lower Congo) Nothing is yet known as to its ecology or economic value, but in general appearance it resembles *M. minutiflora* and might be expected to behave similarly: — 2) *M. tenuinervis* Stapf. (= *M. pilosa*) This species has been confused with *M. minutiflora* but although the hairiness and viscosity of the plant is much less pronounced it might well be considered as a possible substitute in districts where the latter is unsuitable. The structure of the hairs has been thoroughly examined at the Jodrell Laboratory, Kew by S. DICKINSON and full details of the observations are given, with illustrations.

It will be of interest to hear the results obtained with seed of *M. minutifolia* obtained from Columbia, which is now being tested in Sierra

PLATE XIV

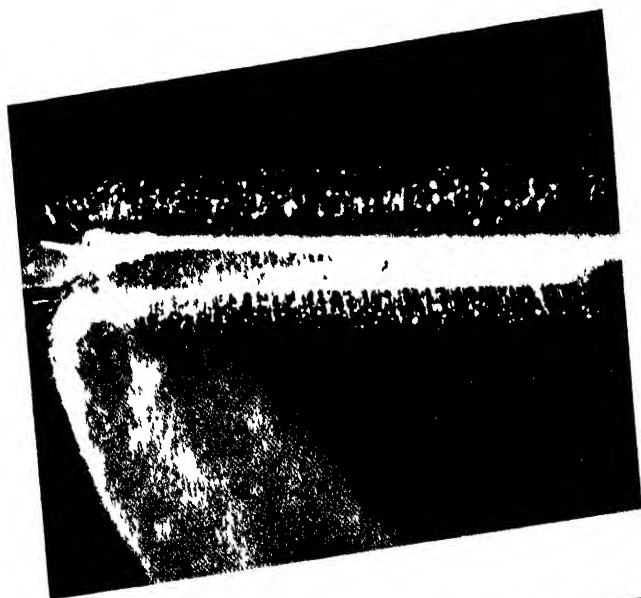
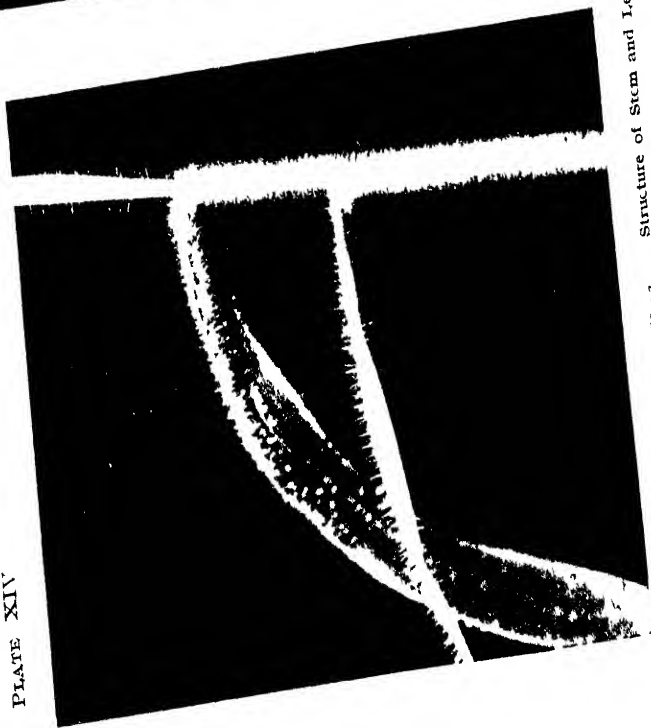


FIG 5152 Structure of Stem and Leaf Sheath of *Yucca microcarpa* L.

Leone, Nigeria and Uganda, where it is intended to grow sufficient grass to carry out a series of experiments to ascertain the uses of this crop.

III. — *M. minutiflora* was introduced into Columbia from Brazil in 1906 by URIBE-URIBE at the same time as another fodder grass known locally as Yaragma (*Andropogon rufus*), and owing to a certain confusion between names and species the *M. minutiflora* was associated with the "yaragma" with the correct local name "pasto gordura". In its native country (Brazil), it also goes under the name of "catingueiro" (= molasses grass in S. Africa).

In Columbia, this plant has been cultivated already to a large extent. It appears to be especially adapted to altitudes of 2500 to 6500 ft. and has proved useful for fattening cattle; the strong odour has no effect on the milk. Less satisfactory results have been obtained with horses and mules. In districts where weeds have proved troublesome, the surface rooting *M. minutiflora* has served a useful purpose.

IV. — Some years ago a small quantity of seeds was introduced into Costa Rica. Although very satisfactory results were obtained, no further steps were taken to encourage its cultivation. The author has, however, continued the trials, and expresses his satisfaction as regards the attractive nature of this fodder plant (confirming the observations reported by T. DAWKINS, I-II), as regards the value of the insecticidal and insect preventive properties of *M. minutiflora* in tropical countries. M. L. Y.

188 The Economic Value of Arghan Fibre (*Argania Sideroxylon*).

I. — MOORE, A. S., Arghan: A New Textile Material. *Journal of the Royal Society of Arts*, Vol LXX, No. 3652, pp. 877-878. London, November 1922.

II — LOWRY, G. A. Arghan. *Ibid.* Vol LXXI, No. 3659, pp. 137-138, and No 3663, pp. 200-201. London, 1923.

III — Arghan: Un nouveau producteur de richesse pour l'Australie. *Revue Agricole, Organe officiel de la Chambre d'Agriculture de la Nouvelle-Calédonie*, No 85, pp. 11-12. Nouméa, November, 1922.

The value of arghan ("wild pincapple") as a textile material has only recently been proved. The principal manufacturers in Lancashire, England, have reported as to the industrial importance of this fibre and state that its tensile strength is 50 % greater than the best hemp and flax, it bleaches well and retains the dye. Equally favourable reports have been received from the Belfast Rope Works, and the fibre appears to be especially useful in the manufacture of twine, rope, nets and cordage in general. It has plenty of natural twist for spinning and may replace cotton for all classes of canvas. No difficulties have been experienced in connection with the preparation, and the leaves split into long silky fibres of a pearly white colour and with a length up to 7 feet. The cost of production is estimated at very little more than that of sisal, but the comparative fibre value is distinctly higher, e. g. 1 lb. arghan gives 980 ft. binder twine compared with 500 ft. for 1 lb. sisal and 680 ft. for 1 lb. manilla.

The value of this fibre was first recognised in South America and *Argania sideroxylon*, also known by the names of, *Bromelia Karatas*, *B. ananas*, *B. macrodentes* and Pita Floja, is now being grown in large quantities.

G. A. LOWRY considers that there is enough arghan growing wild in Central and South America to supply half a million tons yearly. Large areas have a less been set apart for arghan in the Federated Malay States, India and Ceylon. Investigations have been made as to the extent of the wild growth in Columbia, S Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Equator, Venezuela, the Guianas, Peru and Brazil.

Certain difficulties as regards handling (owing to the sharp, hook-shaped thorns), decortication, transport etc have yet to be overcome.

Suggestions have been made as to the utilisation of this crop in Australia and the introduction of the arghan industry into New South Wales and Victoria. Experiments have proved the adaptability of this plant to temperate, sub-tropical and tropical climates; the crop requires very little attention, develops rapidly and gives a large yield M. L. Y.

189 Rubber.

I — WILDEMAN, E D Nouvelles sources de caoutchouc *Le Caoutchouc et la Guttapercha*, Year XIX, No 217, p 11267 Paris, 1922

II — DE WILDEMAN, E Le caoutchouc et la crise *Le Caoutchouc et la Guttapercha*, Year XIX, No 223, pp 11514-11516, No 224, pp. 11545-11547, Paris, 1922

III — MARX, TH and ZIMMERMANN, A Ueber das Klebrigwerden des Kautchuks *Der Tropenpflanze*, XXV, pp 35-41, 83-87 Berlin, 1922

In North America, every effort is being made to find native plants that can supply rubber (I).

The discovery of "guayule" derived from the latex of *Parthenium argentatum*, a tree growing in Mexico, and of "chrysil" which comes from *Chrysothamnus nauseosus* have led the Americans to hope that other plant products similar to rubber, might be found to serve as a substitute, if the supply of rubber were to run short

The family of the *Euphorbiaceae* (to which both *Manihot* and *Hevea* belong), and that of the *Compositae* which includes *Parthenium argentatum* and *Chrysothamnus nauseosus* the respective sources of "guayule" and "chrysil") are not the only groups of plants containing rubber-bearing members. In fact, some of the South American *Loranthaceae* have been found to produce rubber, so that it would be worth while to extend investigations to this family also.

It has been stated that many rubber producing plants exist among the *Apocineae* and *Asclepiadaceae*, but as a matter of fact, except for some species of the genera *Chitandra* and *Landolphia*, their latex more nearly resembles guttapercha than indiarubber.

Recently, the *Asclepias* and especially *A. subulata* have been studied ;

they closely resemble the above mentioned genera and their stems contain 2 to 6.4 % of the guttapercha-like substance.

In the other species, the leaves and not the stems were found to have the highest latex content. The dry material was treated with acetobenzene in order to remove the resin and other non-gummiiferous substances. The percentage variations are very noticeable and depend upon the species and environment, but since they are lower in young trees than in adult trees, it would appear that the latex content is correlated with the vigour and age of the individual.

The leaves of the following species have yielded the percentages of rubber given below

<i>Asclepias sullivanti</i>	12 — 81 %
» <i>syriaca</i>	11 — 44 »
» <i>californica</i>	26 — 43 »
» <i>latifolia</i>	20 — 38 »
» <i>mexicana</i>	1.4 — 48 »
» <i>galicoides</i>	0.6 — 52 »
» <i>brachystephana</i>	21 — 29 »
» <i>speciosa</i>	10 — 50 »
<i>Apocynum cannabinum</i>	07 — 51 »

This rubber is inferior to Para, guayule and chrysl, but could be used if mixed with them in manufactures where great elasticity is not required. The presence of rubber in the leaves is most advantageous, as the fully-developed leaves can be gathered without much injury being done to the tree. In 1910-11, the Torreon factory in Mexico exported 19 749 750 lb. of guayule, of the value of 10 443 000 dollars, to the United States. The amount exported has since diminished, but reached 1 698 000 lb. of the value of 345 985 dollars in 1920-21.

Although this is not a large quantity, it is of some importance to the trade of the country, therefore these new sources of rubber should be studied and made the object of further research.

II — The world's rubber trade is now passing through a very grave crisis. The output was about 300 000 tons, in 1920, but fell in 1921 to 270 000 tons, and stocks are accumulating in England and America while the consumption of rubber would appear to have reached its climax.

The economic situation of rubber may be summarised as follows: financial centre London, maritime centre Singapore, industrial centre Akron. In order to improve the economic and commercial situation, rubber would have to be more widely used, this might be done by increasing motor-car manufacture but the crisis could not be solved by this means, for a more extensive employment of raw material is required to capture new markets and retain old ones, but this cannot be done in a short space of time.

The unfortunate condition in the rubber trade which is a heritage of the War may be regarded, according to De Wildeman, under two aspects: viz. from the standpoint of wild and of plantation rubber respectively. Some persons ignore the first question, for they regard wild rubber as a product of merely historic interest, but as the author mentions, it is still of

great importance to many colonies, and should be made the subject of increased research, and the means of increasing the market value ought to be studied, as its depreciation is often due to prejudice

In order to protect the rubber of the French Colonies the Deputy OUTREY has proposed that a tax of 2 francs per kg be levied on all foreign rubbers imported into France. He thinks this measure would give satisfactory fiscal results and benefit both the colonies and the Mother Country, and further, that the Government should do something to assist the two large French Colonies, Indo-China and Equatorial Africa

DE WILDEMAN regards the present state of affairs as extremely serious for the African Colonies, especially for the French possessions, the Belgian Congo being in a somewhat better case. Rubber is the only product of Central Congo (Ubangi-Chari), therefore, if African rubber is destined to disappear, the Colonies will degenerate into poor countries as the oleiferous raw materials and timber are of too poor a quality to pay for the high cost of transport and could not take the place of rubber in the export trade. Although a considerable amount of rubber is exported from the French Colonies, there has been of late a notable decline in the figures returned from some of them

Years	French West Africa	French Equatorial Africa
1900	925 tons	655 tons
1913	3581	1643 "
1916	1710	2140 "
1917	1114	2996 "
1918	1020	1571
1919	750 "	2528 "
1920	130 "	2122 "

In Madagascar also, rubber production has decreased, from 363 tons in 1900, it fell to 14 tons in 1920

DE WILDEMAN is of opinion that wild rubber might be greatly improved by more careful methods of collecting and preparing the latex and a more thorough scientific understanding of the whole rubber problem. The practice of washing and cutting up the rubber on the spot, which was introduced by MARCHAL into Madagascar previous to 1902, and by VAN PIET somewhat later into French West Africa, will certainly do much to raise the quality of the product. The exploitation of the wild rubber trees is the task of the natives and must remain in their hands, for it would be disadvantageous to try and suppress this industry, although by means of suitable instruction, many improvements could be introduced into the methods of collecting and preparing the latex

Rubber cultivators in Singapore, Borneo, Sumatra and Malaysia, have already begun to suffer from native competition as the natives have started small plantations that are gradually increasing to such an extent as to be serious rivals to the plantations owned by Europeans, owing to the low price of the native grown rubber and the fact that the natives will not be parties to any agreements for the reduction of the output

However, in spite of the alarmist reports of various writers (DE NEVE, F. W. T., HUNGER, P. SEIGNEUR, etc.) native rubber production must not be regarded too pessimistically, for the native is by no means so lazy or opposed to progress as has been believed.

Further, the restriction of production will be of great advantage to the health of the trees in the plantations as intense tapping has altered the composition of the latex and weakened the plant, rendering it more liable to diseases some of which have made their appearance in very serious forms.

The crisis not only affects rubber, but all colonial products, therefore it must be scientifically studied in order to find a remedy. Great judgment must be used in trying to discover some solution to the problem, thus it is imprudent to replace persons who understand making incisions in the cortex by chance workers whose only merit is their cheapness. Such economy imperils the very existence of the plantation.

It is a good plan to reduce the number of trees, for this enables the remainder to develop better, and lessens the working expenses without decreasing the production which, owing to the greater size attained by the trees, becomes normal in a few months.

The work of J. C. J. MAAS have shown that in Sumatra, the number of trees per acre can be reduced from 100 or 200 the 5th year, to 60 in the 10th to 12th year without decreasing the output. This effects a great saving in labour as there are only half the number of incisions to be made. Another advantage in reducing the number of trees is that it provides an opportunity for selection which is very necessary, for as the studies of Dr O. DE VRIES have shown, the trees of the same plantation are by no means equal in their daily production, or in the amount of rubber present in the latex. The selection should also be extended to the soil, because not all soils are suitable for *Hevea* plantations, indeed this is one of the causes of the failure of some Companies.

One method of obtaining a good yield is the proper application of the fumigation treatment. The Rubber Growers' Association recommends the planting of quickly-growing forest trees suitable for the production of creosote-carrying smoke. It will certainly be necessary to try the effect also of other substances which are easily obtained such as hay, coconut husks, saw mill debris, etc.; these however, have the disadvantage of producing smoke of very different composition which may exercise an irregular effect on the latex.

Co-operation is a practical means of reducing the expenses of production, for it allows of costly apparatus being used for treating the rubber of different plantations, thus effecting a great saving in expenditure.

Rubber is a generally well-known and common product in Tanganyika Territory. Its viscosity has already been studied by various investigators, but as the matter is of considerable importance, Messrs. TH. MARX and A. ZIMMERMANN have undertaken a series of researches on Manihot rubber with a view to contributing their quota to the solution of the question.

Dry rubber, on exposure to the direct rays of the sun for one or more days, becomes viscous. The viscosity shows itself more rapidly if the rub-

ber has been coagulated with calcium chloride and Mwengere sap. If recently-coagulated, damp rubber is exposed for some hours to direct sunlight, it does not become viscous on drying. Heat acts just like direct sunlight upon dry rubber. If rubber is coagulated with a mixture of calcium chloride and Mwengere sap, it becomes more readily viscous when heated. Radiating heat, such as is developed for instance beneath a roof of corrugated iron-sheeting exposed to the sun, produces viscosity in rubber. Damp or dry rubber never becomes viscous when mechanically worked unless it is subjected at the same time to the action of considerable heat. In places where sand and red clay are present in large quantities, they can be used to induce viscosity in rubber, the action of the sand being more energetic than that of the red clay. Iron and copper compounds always cause viscosity in rubber. There is no relation between putrefaction and viscosity.

The pieces of rubber coming from old incisions and sometimes met with in deteriorating rubber are easily recognised in the dry product by their dark colour. They often become viscous without however, communicating their viscosity to the sound rubber.

The brown exudations resembling lacquer that are produced on unwashed rubber during drying, are not in any way connected with viscosity. So far, sound rubber has never been found to contract viscosity, which would seem to show that the latter is not an alteration of parasitic origin.

P. C.

190 Curative Value of Chaulmoogra Oil and other Oils for the Treatment of Leprosy (1).

I. — PERKINS, G. A. (Bureau of Science, Manilla) Oils from Seeds of Various Plants for the Treatment of Leprosy *The Philippine Journal of Science*, Vol. XXI, No. 1, pp. 1-14+1 plate. Manila, 1922

II. — CHEVALIER, A. Un remède contre la Lèpre Les vrais et les faux chaulmoogra. *Revue de Botanique appliquée et d'Agriculture coloniale*, Year 2, Bulletin No. 8, pp. 140-146. Paris, 1922.

III. — ROCK, J. F., FAIRCHILD, D. (Agricultural Explorers Office of Foreign Seed and Plant Introduction) and POWER, F. B. (Chemist in charge of Phytochemical Laboratory of Bureau of Chemistry) The Chaulmoogra Tree and some Related Species: A Survey conducted in Siam, Burma Assam and Bengal. *United States Department of Agriculture, Bulletin* No 1057, pp. 29, plates XVI, bibliography. Washington, D. C., 1922

I. — The curative value of the fixed oil (chaulmoogra) from the seeds of *Taraktogenos Kurzii* King, has already been notified. The present paper is written from the chemist's standpoint and deals with the preparation and chemical composition of the leprosy drugs, the manufacture of chaulmoogra ethyl esters, and the medicinal value of of equally effective oils from *Hydnocarpus* spp., *Asteriostigma macrocarpa* (Travancore), *Onchoba echinata* (Sierra Leone), *Pangium edule* (Southern

(1) See R., 1922, No 721.

*Philippines and neighbouring isles). The oil from *Gynocardia odorata* which was often confused with chaulmoogra is totally different both from the chemical and bacteriological standpoint.

The preparation of six drugs other than chaulmoogra, following the procedure of other investigators, is described, which are the medicines selected by the Committee on Leprosy Investigation for experimental treatment.

II — M. CHEVALIER states that according to observations made in Indo-China there is no doubt that the true chaulmoogra oil is derived from *Taraktogenos Kurzii* (= *Hydnocarpus heterophyllus* Kurz = *Gynocardia Pratii* Desprez), first discovered in Burma and Assam. The confusion with the oil from *Gynocardia odorata* and other *Hydnocarpus* spp. is confirmed, but at the same time attention is drawn to the fact that other species of *Taraktogenos* have been neglected which probably are of equal value as regards curative properties e.g. *T. serrata*, *T. subintegra* and *T. microcarpa*, common species in Indo-China.

Observations have been made on *Hydnocarpus anthelmintica*, a tree growing wild in large quantities in the forests of Cochinchina especially in Cambodia. It seems probable that this species gives an oil of identical value to the true chaulmoogra and consequently deserves special attention. Steps are being taken to cultivate this tree, which, however, does not bear fruit before the twentieth year.

Another species, *H. saigonensis*, has been observed in Taninh (Cochin-China) but is scarce.

The great need of a reliable treatment for leprosy demands further investigations on all species likely to possess curative properties.

III. — D. FAIRCHILD confirms the effectiveness of chaulmoogra oil as a remedy for leprosy and gives details of the standard treatment employed. J. F. ROCK traces the history of the true species *Taraktogenos Kurzii* and it is evident that the curative value of the so-called "Kalaw" tree in India has been recognised many centuries ago. During exploration work, the author has recorded various related species viz *Hydnocarpus anthelmintica*, *H. castanea*, *A. Curtisii*, *Asteriastigma macrocarpa* and the false chaulmoogra *Gynocardia odorata*, and describes their habitat and type of fruits and local uses. As regards *T. Kurzii*, the object of the author was to locate the tree in its native habitat and to ascertain whether or not the seeds used medicinally, are those of this species which is widely distributed in Burma. The trees were found growing on steep hillsides on grey loamy quartz sand in a dense, humid, tropical forest, and in pure stands in sandy creek beds. According to observations, *T. Kurzii* produces fruits irregularly; the natives state that they go to the forests to collect seed only about once in three years, and then only in the months of October and November; the fruits mature during the rainy season (May to September). As regards distribution, it is interesting to note that *Shorea robusta*, the famous 'sal' tree of India and Assam is invariably an indicator of the absence of *T. Kurzii* wherever the latter occurs the former is absent, and vice versa.

It has been reported that certain fish (especially *Cirrhitina meigala*)

of the Kassalong river feed on the seeds of *T. Kurzii* and when killed and eaten produce the same effect as would a large dose of chaulmoogra oil. The author mentions all the districts where this species has been found growing in India and concludes by making suggestions regarding the requirements for establishing plantations, an advisable proposition owing to the remote habitats of the wild tree and the danger and difficulty incurred in collecting seeds. The soil should be of a sandy nature, good drainage is necessary and undulating land is preferable; the district should have a distinctly rainy season with a pronounced dry season in the winter months; the temperature should not fall below 40° F. Other species of *Hydnocarpus* require slightly different conditions, but all grow best along creek beds or on the banks of streams. The author recommends a thorough survey, and a chemical analysis of all known species. F. B. POWER gives a description of the investigations so far conducted concerning the chemical constituents of the oils but there remains yet much to be done.

The illustrations show clearly the differences between the true and false chaulmoogra trees and allied species. M. L. Y

Crops.

191. Studies and Experiments connected with Cereal Cultivation in Italy.

STRAMPELLI, N (Direttore dell'Istituto Nazionale di Genetica per la Cerealicoltura Il funzionamento dell'Istituto Nazionale di Genetica per la Cerealicoltura) negli anni 1919-1920 and 1920-1921 *Nuovi Annali del Ministero per l'Agricoltura*, Year II, No 2, pp 311-333 Rome, 1922

A report of an extensive and comprehensive series of experiments carried out under the direction and guidance of Prof. STRAMPELLI, at the Phytotechnical Stations of Rome and Foggia, as well as in selected experiment plots (42 for wheat and 27 for maize) and trial grounds (64 for wheat and 24 for maize) situated in different parts of Italy. The nature of the work renders it difficult to summarise, but the programme for the next year is given.

The attention of the Institute has been mainly directed to obtaining :

1) Varieties of wheat and barley with heavy yield, the former of the type of *Carlotta Strampelli* (up to 45.80 quintals per hectare), *Luigia Strampelli* and *Dauna Varrone*, and barley of the type of *Maraini* etc.;

2) early varieties of wheat and barley the former of the type of *Ardito* (reaped June 17-25, yield 36.83 quintals per hectare), *Bersagliere*, *Ricci* No. 5, on trial (June 7, quintals 40.68), the hybrid *Akakomughi* × (*Wilhelmina tarwe* × *Rieti* No. 30, 1917) on trial (June 14, quintals 32). New types of wheat harvested at the beginning of June, or even earlier, have been obtained at Foggia; of the barleys may be mentioned *Aurora*, *Alba*, *Leonessa*, and of the wheats the three varieties, *Pioniere*, *Eureka* and *Ideale*;

3) drought resistance which is frequently combined with early maturity;

4) resistance to lodging; this has been attained to a high degree

in the type *Carlotta Strampelli* re-crossed with Hizakiri; the hybrid has very short straw;

- 5) resistance to fungus diseases;
- 6) a combination of the above mentioned basal characters;
- 7) adaptation to different regions, localities and soils.

L. V.

192 Experiments with Wheat Varieties in Morocco in 1921.

SCHRIBAUX Essais de variétés de blé poursuivis au Maroc en 1921. *Comptes rendus des Séances de l'Académie d'Agriculture de France*, Vol VIII, No 25, pp 702-705. Paris, 1922

Report presented to the Académie d'Agriculture de France by MÎÈGE, who is especially concerned with the study of the characteristics of soft and hard wheats at the Experiment farm under the Direction de l'Agriculture du Maroc (Rabat); native wheats, seed supplied by VILMORIN, BŒUF, DUCELIER, of the Station d'essais de semences, Paris (SCHRIBAUX) and seed from Australia.

SOFT WHEATS — It appears that under normal conditions, the varieties that are of exceptional quality with reference to one special characteristic, cannot be relied upon in practice and on a large scale to give the best results. It is rather amongst the varieties of good all-round, medium quality that a selection may be made to satisfy the requirements in the colonies

Amongst the comparatively large number of varieties examined, certain examples are outstanding. These are for the most part, grown from seed which has come from the Station d'Essai de Semences de Paris.

Rajah stands first on the list, followed by *Grima de Messaloughi* and *Fan*, and the varieties from the Station d'Essai in Paris viz *1-11 stock 2*, *Baroota Wonder* and *Iguana*, the Australian *Thew* var, *Mahon 124/a* from Tunis, *Bearded Gluyas* and *Riel barbu*

In addition to these 10 varieties found to be the most satisfactory at Rabat, may be mentioned* *G-2 stock 1, M8 plant 2*, from the Station d'Essai, Paris, *Bel Abbés*, No 38; from Maison Carrée, *Blaïete des Puylaurens* and *Tuzelle barhue*, and *Sultan*, *College Eclipse* and *King's Red*. The spelt *Djeghoul* is also of equal value

HARD WHEATS — The selected Tunisian varieties, certain improved Algerian varieties and three selected Vilmorin varieties, which are distinctive and possess special outstanding characteristics

Amongst these the following are of special interest: the Moroccan wheat Battandier, Beloum, Caid Eleize, Mahmoudi Ap 4 and Ac 3, Médéah and Shei., Biskri and Souri, Bel Abbé vars. No. 38, Hedba Pélissier. These have given the best results in 1921 at Rabat.

Amongst the foreign varieties the Sejar de Valencia and Goose Wheat are worth special attention, and also Trigo Macollo and Arnautka are interesting types.

F. D

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193. **Marzellina or Verminia.**

BATTAGLINI, G. (Direttore della Cattedra ambulante di agricoltura di Portomauro) *Nuovi Annali del Ministero per l'Agricoltura*, Year II, No 2, pp 226-236 Rome, 1922.

Marzellina, or *Verminia*, which is also called *Saragouletta* in some districts, is a hard variety of spring wheat grown at S. Bartolomeo in Galdo (Benevento) and in the adjacent provinces of Foggia and Campobasso, where it is continually gaining ground.

Chief characters : short stiff stems, solid even in the lower internodes, which, together with its rapid growth, makes it very resistant to lodging, so that marzellina has produced a crop of 35-40 quintals per hectare on communal land, at S. Bartolomeo, formerly occupied by forests, where all other varieties lodge owing to the excess of nitrogen present in the soil. Roots : strong and well developed. Ear short, compact, strongly awned. Rachis slender, strong, slightly sinuous, with closely-set rather projecting teeth ; spikelet with 2 fertile flowers, rarely with a third median flower producing a less developed caryopsis ; the apical flowers sometimes are unfertilised as a result of bad climatic conditions ; glumes little developed and without awns ; external palae with long (17-19 cm.), almost vertical awns. Caryopses long, pointed, dark-coloured with hard flinty fracture. When, owing to the hot winds, marzellina ripens a few days earlier (*stretta*) the apical kernels are white and have a starchy fracture, as the caryopses are more desiccated than ripened. If however at the time of the "*stretta*" the caryopses are immature, they remain partly white, with starchy fracture. In the case of crops from very friable soil (*suglioni*), there are always a certain number of these white bleached caryopses. If the hot winds blow for several days before the wheat is ripe, they often cause great loss and deterioration of the crop. The damage due to the "*stretta*" could be much reduced by reaping the wheat before it is mature and allowing the grain to finish ripening in the sheaves.

Marzellina flour makes excellent pastry, but if used alone, it imparts a dark colour to them, therefore it is generally mixed with the flours of other hard wheats.

Marzellina compares well with other hard March wheats (*marzuoli*) its specific weight being higher (84.85 per hectolitre) and its starch content larger (66.20 %) etc.

The author carried out a cultural test with marzellina and seven other varieties of wheat in a double series of plots each measuring 100 m². The ground had been cropped with wheat the previous year (following beans) and was manured with superphosphate alone, as owing to having been repeatedly under wheat the land was poor in phosphorus. There was some nitrogen present. Under these conditions, Marzellina produced a rather larger crop than the other wheats (12.75 quintals per hectare as against 10.50 — 12.50). It matured later however than the other hard spring varieties.

The successful growing of Marzellina depends upon the season ; if the weather in the autumn is unsuitable for the sowing of winter wheats,

Marzellina is used to replace them and it is also planted on land which has been left fallow.

Marzellina is very susceptible to "infocatura", a disease probably produced by *Schizoneura corni* and *Tetraneura ulmi* which live in a larval state upon the roots of wheat and other Gramineae, though the adult insects are parasites of the dogwood (*Cornus sanguinea*) and elm. In order to keep these pests in check the rest period must be shortened and wheat grown in rotation with pulse, or forage crops. L. V.

194 Transplanting Wheat.

VIVENZA, A (Direttore del R. Istituto Superiore agrario sperimentale di Perugia), Trapiantamento del Grano *Nuovi Annali del Ministero di Agricoltura*, Year II, No 2, pp 193-196 Rome, 1922

The author suggests "partial" transplanting as a remedy for thin crops

Plants are grown in the nursery to replace those that have not come up, or have grown badly, owing to defective sowing, insect or fungus attack (especially in the case of some meadow species), stagnant water resulting from floods or defective drainage, etc.

For some years, the author has been carrying out tests in the wheat experiment field at Perugia, and has found that throughout the tillering period, that is to say, from shortly after germination until March or April, transplanted wheat can take root, as the roots quickly re-establish the relations between the seedling and the soil. The best results were, however, obtained in the middle of January. Practically, replanting is possible and easy under climatic conditions such as are usual from the end of November to the middle of January, and in some years, even to the end of the latter month, viz, during the first half of the tillering period.

The seedlings need not be raised in the nursery, they can be taken from the thickest part of field itself, or of some other seed-bed. A small nursery is certainly convenient, but the wheat must be sown early in well-worked liberally-manured soil, and about three times the normal amount of seed should be used. The seedlings are easily lifted, especially when they are in the first stage of tillering (with 3 shoots), or a little more advanced. The whole tuft is grasped by one hand, while the roots are dislodged by means of inserting the fingers of the other hand, or a trowel, into the soil. If the seedlings are very thick, two or more can be taken up at a time. The uprooted seedlings are transported in a basket, or box. On soft damp soil, transplanting can be done by hand, or with implements such as an ordinary transplanter, or trowel, or better still, a stransplanter of oval shape and with a handle in the form of a T. The seedlings are planted singly, or two together, but not in groups. Care must be taken to see that the roots descend into the hole made in the soil, while the collar remains 2-3 cm. below the surface, or a little lower than the position it occupied before the seedling was transplanted. The seedlings may be in rows, or scattered, but need not be as close together as those that have grown *in situ*; when the operation is complete, there should be about 70

single plants, or 50 pairs to the m². The transplanting is best and quickest done in rainy weather, although the ground must not be saturated with water. If the seedlings are put in during fine weather, they will need a little watering, especially if the ground is dry. It is a good plan to dissolve a fertilising, or growth stimulating substance in the water; 10 gm. of sodium nitrate in 10 litres of water are enough for about 100 seedlings.

In 1922, large bare patches occurred in many of the wheat fields, and in the worst cases, the farmers tried sowing spring oats, or some March wheats to fill up the gaps. The success of these remedies is, however, somewhat uncertain, as the various grains ripen at different times, and it is troublesome to separate the oats from the wheat. It would be better on such occasions to have recourse to transplanting. I. V.

195. Classification and Detailed Description of Barley and Oats of Australia.

ARCHER, E. Secretary and Investigator Special Committee on Seed Improvement. Barley *Bulletin No 22, Commonwealth of Australia, Institute of Science and Industry*, pp 33, figs 3 Melbourne 1922. Oats *Bulletin No. 23, Ibid* pp 31, plates 4 Melbourne, 1922.

Samples of the varieties for different seasons were obtained from the Experimental Farms throughout Australia and the Seed Improvement Committee has compiled an excellent and instructive classification of the sub-species and varieties of barley and oats with comprehensive illustrations. The main points of distinction between the various species are noted and the varieties classified accordingly.

The cultivated baileys in Australia all belong to one species (*Hordeum sativum*) divided into a number of sub-species, types and strains. The key to the varieties is very complete in every way. The two-row types include var. *mutans* e. g. Kinver, Chevalier, Archer, var. *erectum* e. g. Duckbill, and the less common varieties, *zeocriton* and *macrolepis*.

The six-row types include var. *normalc*, e. g. Barley 36, and var. *vulgare* e. g. Roseworthy Oregon, Cape, Algerian, etc.

The very small group *Hordeum intermedium* is of little importance.

The only three species of oats of importance in the country are *Avena sativa* e. g. Rakuara, Lachlan, White Ligowo, etc.; *A. orientalis*, e. g. Banner, Tartarian, etc.; *A. sterilis*, e. g. Algerian, Calcutta, Red Rust-proof, etc. A detailed account of the wild oat, *A. fatua*, is included and an interesting comparison is made of the characters of the basal hairs, awns, straw, foliage, panicles, spikelets, glumes and husk, in addition to the character of early growth. The key to the varieties is equally complete.

M. L. Y.

196 Rice cultivation and Antimalarial Control.

KONSULOFF, S (Member of the Inspectorate for the control of malaria in Bulgaria) Die Bekämpfung der Malariaimpfen in den Reisfeldern *Zeitschrift für angewandte Entomologie*, Vol. VIII, Part 2, p. 283-294. Berlin, 1922.

In continuation of experiments made *in vitro* and in the open, which proved the small power of resistance of anopheles larvae in a moist sub-

stratum subjected to the action of sunshine, the writer has tried successfully the following technique in a rice field at the Sadow Agricultural Experimental Station (Southern Bulgaria). He suggests that rice growers should test it:—

Level the bottom of the rice field so that no holes deeper than 5-6 cm remain, in which larvae might shelter from the larvicidal action of the sun. From the middle of April to the middle of September, remove the water from the rice-field twice a month for a duration of 1-2 days each time in summer and of 3-4 days in spring and autumn, choosing cloudy days. It is best to draw off and reintroduce the water at night. The larvae are not carried away by the current to any great extent, but are almost all found at the bottom, where they are killed by the heat of the sun. The rice does not suffer from this treatment.

L. V.

107 Some New Varieties of Rice obtained in the United States.

CHAMBLISS C E (Agronomist in charge of Rice Investigations, Office of Cereal Investigations), and MITCHELL JENKINS J (Superintendent Rice Experiment Station, Crowley, La) *United States Department of Agriculture, Department Bulletin No 1127*, pp 17, plates 4 Washington D C, 1923.

A description of the rice plant and a botanical description of seven new varieties that have been obtained in the course of experiments at the Rice Experiment Station Crowley on silt loam, in co-operation with the Louisiana Agricultural Experiment Station and the Office of Cereal Investigations (U. S.) The preceding crop, soy beans, was sown as a green manure and apart from this no fertilisers were employed. Irrigation commenced 30 days after the rice plants emerged. Throughout the growing season an average depth of 5 inches of water was maintained. The varieties concerned (viz Fortuna, Acadia, Delitus, Tokalon, Evangeline, Vintula and Salvo), are developed from pure-line selection. The culinary properties have proved of commercial value as the kernels retain their natural shape and remain separate when boiled, a popular characteristic.

As a whole (with the exception of Acadia) the varieties are long-grained, especially Fortuna and Salvo (10.3 mm) and apart from this, certain distinct characteristics as regards type, maturity and yield are worthy of note.—

Fortuna (pure line from the Formosan Pa Chiam variety). Matures in about 142 days, has given excellent grain on new land near Carville (5366 lb. per acre) and gives good yields on poor soil. On rich soil it has a tendency to lodge; should be harvested early to prevent shedding of grain.

Acadia (from the Japanese "Omachi" variety), matures in about 139 days; has produced as much as 5155 lb. per acre on new land in the Mississippi River section and 4702 lb. on old rice land and 3800 lb. on prairies in south-west Louisiana.

Delitus (from the Italian "Bertone" variety), matures in about 131 days; although the yielding capacity is not large. This rice is pop-

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ular owing to the distinct flavour of the kernels, resembling that of maize. This is peculiar to no other rice grown in the United States except *Salvo*.

Tokalon (from the Philippine "Carangiang" variety), matures in about 143 days, produces larger yields on clay soils of the prairies than on the alluvial Delta lands, the tendency to shed grain may be prevented by early sowing. — This variety gives a higher yield on poor soils than any grown on the coastal plain in the Louisiana-Texas rice belt; — the white thin bran of the kernel might be used to meet the increasing demand of "brown" or "natural" rice.

Evangeline (from an unnamed Guatemala variety); matures in about 122 days, grows on very rich land without lodging and has given as much as 3420 lb. of grain per acre, and on the ordinary prairie lands in the southwest, 1850 lb. per acre.

Vintula (from unnamed Ceylon variety); matures in about 123 days; on lighter soils the yield is slightly over 2000 lb. per acre, and about 4000 lb. on delta lands of the Mississippi River Section

Salvo (from the Java "Djemmer" variety); matures in about 144 days; well adapted to lighter soils of South-Western Louisiana; has a maize flavour.

In addition to these new pure-line selection varieties a description is given of 4 long established commercial varieties viz., Honduras, Watari-bume, Blue Rose and Shinriki. With the exception of Honduras these are medium and short grained.

Honduras (imported from Honduras); matures in about 123 days; the principal long-grain rice grown in Louisiana, Texas, and Arkansas; has given up to 2045 lb. per acre on new prairie lands in Arkansas and 1914 lb. on Delta lands; the milled product has always a ready market.

Wataribume (grown from seed imported from Japan); matures in about 137 days; should not be sown on very rich soil owing to tendency to lodge.

Blue Rose (selection from Japanese rice), matures in about 148 days; the growing period is long compared with other varieties; the kernels resemble those of Honduras, and hence its popularity, but lacks culinary properties.

Table showing average yields of new and established rice varieties

	Long-grain							Short-grain			Med- ium grain
	Fortuna	Delitus	Tokalon	Evangeline	Vintula	Salvo	Honduras	Acadia	Wataribume	Shinriki	Blue Rose
(lb per acre)											
Yield of grain	2 530	1 862	2 443	2 027	2 086	1 774	1 834	2 884	2 727	2 500	2 086
Yield of straw	2 210	1 350	2 310	1 191	1 149	1 790	2 303	2 020	1 777	1 734	2 520
Average yield 5 years (1917-21)	2 678	1 761	2 440	2 004	1 913	1 590	1 806	2 728	2 657	2 506	2 126

Shinriki (introduced from Japan); matures in about 134 days; does not cover a wide area owing to shortness of culms and loss of grain when cutting.

The stems and foliage of all the varieties, except *Delitus*, *Evangeline*, *Vintula* and *Honduras*, retain their green colour after the grain ripens.

None of these varieties show complete immunity to the disease caused by *Piricularia oryzae* Br. and Cav.; *Honduras* is very susceptible and the others are liable to attack if left uncut too long after maturity.

M. L. Y.

198 Vegetable Oils of Brazil.

264 TEIXEIRA DA FONSECA, E (Ministerio da Agricultura. Rio de Janeiro). Oleos Vegetaes Brasileiros, pp 1-130, bibliography Rio de Janeiro, 1922.

The importance of vegetable oils to cope with the present demand is accentuated. Various decrees have been passed in Spain, Germany, Tunis, French West Africa, Italy, Poland, Portugal and Czecho-Slovakia, to encourage the production and commercial interests with reference to oils. In Brazil, considerable attention has been given to this question, and an official order has been issued for the establishment of an Experiment Station for the cultivation of the oil palm, etc

The export and import data (1910-1920) show the importance of intensifying research on vegetable oils in Brazil, if the imports are to be decreased

The following analysis of the oils from the various species in Brazil has been made (Table page 396)

A list is given of the species considered to be possible sources of oil and in the majority of cases a chemical analysis is given and their commercial value. The following species are included in the list.

Abacate (*Persca gratissima*, Gaertn Lauraceae, Algodão (*Gossypium* sp. pl N. O. Malvacea, Almecegueira (*Bursera balsamifera*, N. O. Burseraceae), Ameixieira (*Ximena americana* Linn N. O. Olacaceae Amendoim (*Arachis hypogaea*, Linn, N. O. Leguminosae, Andessa (*Solanum princeps* Vell N. O. Euphorbiaceae, Andiroba (*Carapa guyanensis*, Aubl. N. O. Meliaceae "Andiroba" also refers to (*Feuillea passiflora* Vell., *F. trilobata*, Linn. and *Anisoperma passiflora* and, N. O. Cucurbitaceae. Seeds supply. oil). Aricuri (*Cocos coronata*, Mart. N. O. Palmaceae, Aroteira (varieties of Gen *Schinus*. N. O. Anacardiaceae. Ayny (*Astrocaryum ayyi*, Mart. = *Toxophoenix aculeatissima* Schott N. O. Palmaceae; babassu (*Attalea speciosa* Mart = *Orbignia Martiana*, Bart. Rod N. O. Palmaceae Bacaba (*Oenocarpus distichus*, Mart. O. bacaba Mart.), N. O. Palmaceae. Bacupary (*Rheedia brasiliensis* Pl and Tr. N. O. Guttiferae, batiputa (*Gomphia parviflora* D. C.), baunilha (*Vanilla planifolia* Andr. N. O. Orchidaceae, bicuhyba or ucumba (*Myristica Sebifera*, Swartz., M. *Surinamensis*, Ros. N. *bicuhyba*, Scholl., N. O. Myristicaceae; borracha (*Hevea brasiliensis* Mav. Euphorbiaceae; burity *Mauritia vinifera* Mart Palmaceae), Cacao (*Theobroma Cacao* Linn., Sterculiaceae), Cajú (*Anacardium occidentale* L. Anacardiaceae). Capim cheiroso (*Killingia odorata* Vahl., Ciperaceae), Carnauba (*Copernicia cerifera*) Mart., Palme), Castanha do Para (*Bertolletia excelsa* K. B. K., Lecitidaceae),

Composition of Brazilian Palm Oils.

VARIETY	Weight per 100 fruits or seeds	% Nut		% Oil		Point of fusion	Point of con- solidi- fication	Point of solidi- cation	Refrac- tive index Zeiss at 40°C	Iodine index	Fatty acids (free)	Sapo- nifiable matter
		%	Nut	%	Pulp	Fruit or seed	Point of fusion	Point of solidi- cation				
	gm.	%	%	%	%	%	%	%	%	%	%	%
<i>Elaeis guineensis</i> (dendé) of Manaoas	650	16.7	34.7	46.9	17.7	28.5	30.2	27.3	23.4	40.5	25.5	0.55
" " of Amazonas	320	25	36.7	19	12.5	28	31	27.8	220.2	42.7	31.6	0.33
<i>Astrocaryum vulgare</i> (tucum)	1900	20	43.5	37.5	21.4	29.4	30.6	28.6	240	36.3	12.2	0.54
" " sp.	1250	46	52.2	—	38.5	32.5	32.5	34	245.2	39.5	13.9	1.65
<i>Acrocomia sclerocarpa</i> (coco de catarrho).	3300	6	40.2	63.7	18.7	21	22	194	237	37.2	16	0.4
<i>Maximiliana regia</i> (inaia)	738	12.5	60.15	—	26	28.5	253	249	246	40.1	30	4.7
<i>Cocos syagrus</i> (pererema) <i>Cocos syagrus</i> (oblong fruit).	1100	40	32.1	—	23	29	268	252.2	37.4	12.5	3.2	—
<i>Cocos syagrus</i> (pointed fruit)	600	41	23.0	—	23	28.7	—	—	36.2	13.4	2.97	—
<i>Attalea funifera</i> (plassava)	11200	—	65.7	—	22.2	26.1	22.7	—	246.9	37.1	16.3	2.80
<i>Oenocarpus batava</i> (patassa)	—	—	—	—	—	—	7	191.8	52.5	78.2	0.48	1.1
<i>Myrsine</i> (Virola) <i>biculytia</i> (ucunba)	131	82	69.4	—	57.8	41.7	43.3	40	220.3	59.9	14.1	17.5
" <i>platylerma</i> (biculytia)	—	—	59.3	—	32.6	41.0	42.0	39.8	239.5	37.1	4.98	3.2
<i>Penadiethra filamentosa</i> (pracachy)	435	72	51	—	36.0	—	—	14	177.0	52.8	68.96	0.20
<i>Caryocarpus</i> sp. (pitiá)	1800	79	50.8	—	40.3	18.4	14	140	181.3	57.8	100.4	0.08
<i>Marinus-Martin</i> vegetal (jarina)	1855	23	70.4	—	16.2	30.5	37	286	197.6	46.2	41.86	1.37
<i>Mahibarana</i>	167	51	62.3	—	31.7	—	—	0	196.2	90.3	124.2	8.7
" <i>macrophylla</i>	—	90	70.9	—	40	40	40	—	245.1	41.5	20.98	22
<i>Carapa guineensis</i> (andiroba)	1800 about 74	57.85	—	—	42.7	—	—	—	197.0	50.0	62.2	18.6
<i>Onphalea megacarpa</i> (mae de azeite).	1980	76	66.75	—	50.7	—	—	—	192.2	58.4	115.8	3.57
<i>Fachira</i> sp. (mamorana)	—	82	53	—	47.6	18.31	40	—	206.7	47.2	41.7	0.56

Caucho (*Castilloa elastica* Cerv., Artocarpaceae), Cinnamomo (*Melia azedarach* Linn., Meliaceae), Coco da Bahia (*Cocos nucifera* Linn., Palmaceae), Copahyba (*Copahifera* sp. pl., Cesalpiniaceae), Cravo (*Dicypellium caryo, phyllatum* Nees N. O. Lauraceae), Cumarú (*Dipterix odorata* Willd., *D. oppositifolia* Willd. N. O. Papilionaceae), Curna (*Attalea spectabilis* Mart., N. O. Palmaceae), Dendé (*Elaeis guineensis* Jacq., *E. melanococca*, N. O. Palmaceae), Fumo (*Nicotiana* sp. pl. Solanaceae), Gergelim (*Sesamum indicum* D. C., *S. orientale*, N. O. Pedaliaceae), Jerivá (*Cocos comosa* Mart., *C. oleracea* Mart. N. O. Palmaceae), Laranja, Macauba (*Acrocomia sclerocarpa* Mart., N. O. Palmaceae), Manicoba (*Manihot* sp. N. O. Euphorbiaceae), Melão (*Cucumis melo* L., Cucurbitaceae), Milho (*Milium* sp., Graminaeae), Nogueira (*Aleurites triloba* Fort., *A. Moluccana* Willd., Euphorbiaceae), Oliveira (*Olea europaea* L., N. O. Oleaceae), Pindoba (*Attalea humilis* Mart.), Pinhão de Purga (*Jatropha curcas* Linn., Euphorbiaceae), Pignia (*Caryocar brasiliensis* Camb., Cariocariaceae), Pupunha (*Guilielma speciosa* Mart. N. O. Palmaceae), Quaresma (*Cocos flexuosa* Mart., N. O. Palmaceae), Ricino (*Ricinus communis* Linn. Euphorbiaceae), Sapucaia (*Lecythis grandiflora* Pis. N. O. Lecitidaceae), Sapucinha (*Carpotroche brasiliensis* Endl., N. O. Flacurtiaceae), Tucum (*Astrocaryum vulgare*, N. O. Palmaceae), Urucuba (*Myristina subsessilis* Benth, Myristicaceae), Urucury (*Attalea excelsa* Mart. N. O. Palmaceae), Uva (*Vitis vinifera*, Linn. N. O. Vitaceae). F. C.

199 Report on the Trade in Indian Myrobolans.

Indian Trade Enquiry Drugs and Tanning Materials, Imperial Institute, pp. 41-50 + Export statistics London, 1922.

A summary of the Indian export trade in dried fruits of myrobolans. (*Terminalia* spp.). A description is given of the method used for collection of fruits from the principal source of the myrobolans of commerce, *Terminalia Chebula*, found throughout India and Burma, chiefly in deciduous forests. As regards time for gathering, it has been found that the ripe fruits contain the largest proportion of tannins (44.76 %), the half-ripe and over-ripe fruits containing 38.54 % and 37.53 % respectively. A comparative analysis has been made of the local commercial samples.

The Imperial Institute Committee for India has consulted the tanning experts as to the use of myrobolans, and summarises their opinion. The following conclusions have been drawn:

- 1) Mixed tannages are a distinct advantage, e. g. quebracho with 23 to 30 % myrobolan, mimosa with 15 to 20 %, and mangrove with up to 50 % myrobolan.
- 2) Whole nuts are preferred.
- 3) Solid extracts are less satisfactory for tanning purposes than liquid extracts.

As regards the use of myrobolans in the dyeing industry, the preference is again given to entire nuts ground into fine powder, or the extract, rather than the crushed fruits. The value as a fast dye has been proved.

Suggestions have been made as to improved methods of collection and grading and the form of export and special machinery for cracking the stones, and separating the kernels, also the possible utilisation of crushed myrobalans. Further investigations are considered to be necessary in connection with the above problems.

M. L. Y.

200 The Practical Use of Latex Weight Records.

GRANTHAM. J. The Utilisation of Latex Weight Records for Field Experiments. *Archief voor de Rubbercultuur in Nederlandsch-Indië*, Year VI, No 12, pp 484-512. Buitenzorg, December 1922

These experiments were undertaken by the author with the object of determining the following points.—

1) The variations in the concentration of the latex from different plots.

2) Whether these variations tend to diminish after a certain period of time, or whether the concentration of any given plot is relatively constant

3) Whether any correlation exists between the rubber concentration and the latex yield of the individual plots

4) Whether the weighing as usually practised in the plantations is sufficiently exact.

5) How far it is easy to determine the differences in concentration due to differences in treatment

The author experimented with 69 plots for 44 days, and found that the probable error caused by the method of taking the samples would in no case exceed 1.8 %. If this error is distributed over a period of several days it becomes very insignificant

The degree of variation occurring between plots of 5 acres is such that no importance can be attributed to a difference of less than 5.5 % in the dry rubber present in the latex on favourable days, and of less than 9.1 %, on unfavourable days. It may happen that one day there may be great differences between the weight of the latex of two plots, although an equal amount of dry rubber is obtained from both.

A slight equalisation of the variations is found if the average of a 44 days period is taken, but it is much less than would be expected if all the plots varied around a common average. The probable error of the average rubber concentration of latex is 0.94 %, viz, 2.54 % of this average. A difference of less than 4.23 % in the dry rubber content of several plots during a period of 44 days does not denote any real difference between these plots.

Since a slight correlation exists between a large latex yield and a low rubber concentration and inversely, a probable error of 2.54 % is not sufficient for estimating the probable dry weights on the basis of the weight of the latex. A probable error of 3 % may be regarded as enough. The usual method of weighing the latex is sufficiently accurate if a correction is made for the deviation of each plot from the weight of the average plot.

In experiments, at least 30 parallel plots must be used, in order to

ensure that the 1 % differences between the experiment plots and the controls are really due to differences of treatment.

It is useless to add every day a correction for the " lump " in determining the dry weight of each lot according to the latex yield and latex concentration, when the observation period lasts 44 days.

If the weight of the dry rubber produced in a certain period is calculated on the basis of the total latex yield and latex concentration for that time, the figure obtained will be very near that found by daily estimation.

The author draws all these conclusions from the data given in 7 tables which are appended to his article,

D. V. S.

201. On the Advantages and Disadvantages of Grafted Rubber Plantations in the Dutch East Indies.

ARISZ, S. H. Over de voor- en nadeelen van oculatie aanplantingen van Hevea. *Archief van de Rubbercultuur in Nederlandsch-Indië*, Year VI, No 12, pp. 157-161. Buitenzorg, December 1922

The author quotes an article by Victor Ris of Delhi, on the rubber plantations of the future (*Archief voor de Rubbercultuur*, June 1922), in which special attention is given to the importance of the condition of the soil, in connection with rubber production. On rich soil, as much as 2000 lb. per acre has been obtained from the trees in Delhi.

In Besoeki (Java), conditions are different. The plantations are situated above sea level at a much higher altitude and the climate is drier, which factors have a distinct influence on yield. A description is given of the grafting tests made at Pasir Waringan (see R. Jan.-March 1923) and it appears that the seeds from healthy trees with a normal yield should be used to propagate stock. It is not wise to trust to a single parent stock even if it is considered superior but rather to employ a large number of good quality stocks and to make an arbitrary but systematic choice in such a way as to be able finally to thin out in a suitable manner.

Trees should be planted 18 × 18 ft. to allow free development up to the sixth year. Grafted trees should, during the first years of tapping, give a very high yield, as much as four times that of plantations propagated from seed. Later, however it should not be expected to maintain this higher production as it is necessary to thin out, whereas on a seed sown plantation, thinning is restricted to inferior trees. The author draws attention to the question of pruning of trees instead of thinning out. The maximum yield will depend more on the general condition of the plantation, soil, altitude, rainfall etc., than on the development of the latex vessels.

The principal difference between a grafted and a seed sown plantation lies in the fact that grafted trees give a superior yield during the early years.

In the case of high yields it is necessary to enquire whether fairly rich soils are able to maintain the rate of production without manure. For example, in the production from one acre of 2460 lb. of rubber, or 1320 gallons of latex containing about 0.3 % nitrogen, 40 lb. of nitrogen are removed each year, which corresponds to about 198 lb. of sulphate of ammonia.

The chief drawback lies in the fact that insufficient is known as to the

qualities transmitted by the selected parent stock. On all the plantations it would be advisable from now onwards to compare the characters of the grafts on different parent stocks.

D. V. S.

202 **Results obtained with Grafts of *Hevea Brasiliensis* in the Pasir Waringin Plantation, Java.**

VISCHEER, W. and TAS, L. Resultaten bereikt met oculatees van *Hevea Brasiliensis* op de onderneming Pasir Waringen; een bijdrage tot de vraag, in hoeverre aantal latex vaten en productie raskenmerken zyn. *Archief voor de Rubbercultuur in Nederlandsch-Indië*, Year VI, No 11, pp. 416-443, pl. 3, figs. 1, bibliography. Buitenzorg, 1922

The author has previously published data on the anatomical characteristics associated with certain *H. brasiliensis* grafts, and he summarises the results as follows:

After grafting, the stock and scion retain their specific characters. The number of latex vessels in the scion is independent of those of the stock. In a mixed plantation there is little or no correlation between diametrical growth and the number of latex vessels. In a plantation grafted on one kind of stock the contrary effect has been seen and the type was uniform throughout, the trees of a certain girth having also the same number of latex vessels.

At the present time the author is studying grafts of 4 ½ years, from the botanical and practical standpoints. Up to a certain point the characteristics of *H. brasiliensis* are inherited.

The mother stock was planted in 1907-1908 and gave the following yields expressed in grammes of dry rubber per day:

The number of latex vessels 1922.

	1916	1917	1918	1919	1920 1921
P. W . . 34 . .	26 0	37.3	45 3	43 7	25 unhealthy
P. W . . 225 . .	43 0	48 6	56 2	65 0	37 (a)
P. W . . 2 . .	37 —	45 —	49 —	59 —	27 —
P. W . . 217 . .	47 —	47 —	unhealthy		
P. W . . X . .		not recorded			

The number of latex vessels 1922

	at height of 1.6 m.	at height of 5 m.
P. W . .	34	53
P. W . .	225	45
P. W . .	2	50
P. W . .	217	62
		at height of 5 m.
		24
		28
		18

It should be noticed that P W 225 with the smallest number of latex vessels gives the highest corresponding yield, and the bark is thicker than that of P W 34 and the vessels further apart



FIG 53 — Plantation of grafted rubber trees of 5 years old (grafts from 2 parent stocks)
Differences of branching should be noted

The development of the grafted trees is excellent. The habit of the tree resembles that of the common *Hevea* but there is a tendency to form branches at an early stage. By removing the buds, however, this can be remedied and a trunk of equally fine quality will be produced. The branching and the general shape of the mother stock is reproduced in the graft, and the trees are easily recognised from a distance.

Anatomical studies. — In 1919, bark was collected round the nodes of several trees in group P. W. 34. This year the author has examined the renovated bark and concludes that the cambium of the lower part of the trunk and of the scion retain their specific properties; there is therefore no relation between the number of vessels of the two sections.

Measurements of girth and the number of latex vessels of all the grafted trees were made at a height of 1 m. The author has tabulated all the results obtained. It appears that the relation between girth and number of latex vessels differs for each *Hevea* species, but remains constant for the same type, and that this relation is associated with the specific properties which are perpetuated from parent stock.

Production. — Further tables indicate the yield per group. It is difficult to state if as a general rule the yield of grafted trees is large or the contrary as the author has not sufficient comparative data available. Group P. W. 34 gives the very high yield 7 gm. per day.

It appears also from these tables that the progeny of one plantation varies little as regards production. The average is either all good or the reverse. There is a distinct variation in type which means that the yield of one variety may be double and even triple that of another type.

If the grafts of one special type are studied separately it may be seen that a close relation exists between yield, girth and number of latex vessels, a relation which is far less accentuated with trees propagated by seed.

With group P. W. 34, for example, the production is increased in direct ratio with the number of latex vessels and with the thickness of the trunk.

Hitherto only vegetative propagation of a special type of *Hevea* has been possible; grafts of a high yielding specimen will now, however, be recognised as of great value as regards latex yield, and also for seed purposes.

In conclusion, the author encourages further selection work in Java.

D. V. S.

203. Kauri Gum from *Agathis australis* in New Zealand.

Bulletin of the Imperial Institute. Vol. XX, No. 3, pp. 331-337. London, 1922.

The *Agathis australis* covers a wide area of New Zealand (North Island) between latitudes 34° and 38° S. Two forms of the Kauri gum are met with in commerce, the fossil gum dug from the ground, and the gum obtained by bleeding or tapping the living tree.

A description is given of the methods employed to recover the gum from the ground, and a recent process (Maclaurin) which has been in use for over two years at the Government Kauri-gum store in Auckland, is reported as the most efficient and practical method. The crude gum is introduced into a cone-shaped tank together with a strong solution

of salt (specific gravity 30° Tw). The contents of the tank are agitated and the air pumped out. The gum rises to the surface of the brine and the dirt etc. sinks to the bottom and can be easily separated by running off the solution with the dirt in suspension into one tank and the upper portion of the solution with the gum into another. The brine solution is recovered by filtration from both solutions, the gum well washed to remove all traces of salt and finally dried.

Bleeding in recent years has been conducted on fairly systematic lines; the trees are retapped after 6 months.

The Commission appointed to inspect and classify Kauri-gum in the Auckland District advises a general use of the *Maclaurin* separation process and further investigations on the effect of bleeding the trees and in connection with Kauri gum peat and other by-products.

Experiments have shown that from 1 ton of Kauri peat a yield of 40 gallons of crude oil is obtainable, and on fractional distillation 10 % is suitable for motor spirit, 80 % heavier oils and 10 % pitch. Briquettes have been made with the by-products of distillation and have given excellent results.

M. L. Y.

204. Data relative to the Different Varieties of Sugar Cane in the 1921-22 Harvest in Java.

J VAN HARREVELD, in *Archief voor de Suikerindustrie in Ned Indië*, Year XXX, Part. II, pp 391-412

Eight tables concerning:— 1) Distribution of sugar cane varieties in each plantation throughout Java, 2) the same for each province; 3) data from table 2, expressed in rates per cent; 4) total area planted with each variety; 5) distribution of varieties from the nurseries in the low-lying districts; 6) ditto in each province and limits of the total area occupied by each of the three types of sucker viz.

a) cuttings taken direct from cropped canes;

b) cuttings taken direct from nurseries in low-lying districts;

c) cuttings from nurseries on the mountains.

7) the number of suckers from each variety, from nurseries on the mountains per plantation; 8) the same from each province.

During the year 1922, the variety E. K. 28 occupied an area of 56 800 hectares viz. 39 % of the total area planted with sugar cane in Java; the other varieties in order of importance are DI 52 (18 $\frac{1}{2}$ %), 247 B (97 $\frac{1}{4}$ %), EK 2 (6 $\frac{1}{2}$ %), 100 POJ (4 %), 90 F (3 $\frac{1}{4}$ %), SW 3 (2 $\frac{1}{2}$ %), 2714 POJ (2 %) and 2725 POJ (1 $\frac{1}{2}$ %).

J. K.

205. *Crotalaria anagyroides* as a Green Manure on Tea Plantations in Java.

KENCHENIUS. A *Crotalaria anagyroides* als groenbemester De Thee (Korte aantekeningen van het algemeen proefstation voor thee). Year III, No. 3, pp 71-74, figs 1 Batavia, 1922.

Following on the unsatisfactory results obtained in 1918 with *Crotalaria usaramoensis* as a fibre plant, various new species have been introduced



FIG. 54 — *Cynodon dactylon*, nearly four months

into Java at the request of the Director of the Breeding and Seed Testing Station at Buitenzorg and the Botanist at the Herbarium van's Lands Plantentuin (Herbarium of the Botanic Gardens). Amongst these, *Crotalaria anagyroides* merits especial attention owing to its rapid growth.

This plant is estimated to produce in the 3 months between the rice harvest and the preparation of the rice fields, some 37 450 kg. per hectare of green material. At first some difficulty was found when ploughing in this plant owing to its woody nature, but a species was then cultivated which had not this drawback. Analysis indicates that this plant contains at the age of 3 months : 20 % dry matter ; 1.59 % nitrogen and 0.49 % phosphoric acid. As a fertiliser it is equivalent in value therefore to a manure containing 596 kg. per hectare of nitrogen, such as sulphate of ammonia, and 92 kg. per hectare of phosphoric acid, such as double superphosphate.

The digging in of green manure on the same soil where it is grown makes no difference to the total content of nitrogen, phosphorus, etc. in the soil, as these elements were derived from that soil, but they are rendered more readily assimilable for crop purposes, in this case for tea. The green manure is in fact equal in benefit to an inorganic manure.

At Buitenzorg, *C. anagyroides* reaches a height of 2 ½ m. at the end of 3 months, after 6 months the seed is ripe and of good germinating capacity.

At an altitude of 1600 m. growth is retarded and at the end of 8 months the plant only reaches a height of 1 ½ m.

On plantations where *Crotalaria* is sown between the rows of tea, the plant is cut back after reaching a certain height, according to the type of plantation ; the cuttings are then dug in at once, if possible with slaked lime (220 kg. per hectare) and a similar quantity of wood ash.

On all plantations which intend to utilise *Crotalaria anagyroides* as a green manure, it is advised to reserve a special field to raise seedlings, which is easy to maintain, and to sow 2 seeds every 10 cm. in rows 80 cm. apart ; 7 kg of seed is sufficient per acre. The labour of weeding is unnecessary, as *Crotalaria* prevents the growth of weeds.

Not only in the tea plantations this plant is useful but also on newly cleared land. Ploughing in one month before planting the tea is advocated.

D. V. S.

Arboriculture.

206 Comparative Cropping of Apple Trees in Relation to Habits of Parent Stock.

RAWES, A. N. (Officer in Charge of Fruit Experiments) *Journal of the Royal Horticultural Society*, Vol. XLVII, Pts 2 and 3, pp. 163-168, bibliography, London, 1922.

The object of the experiment made in the Royal Horticultural Society's Gardens, Wisley, was to ascertain whether apple trees propagated by buds or scions taken from trees that had carried comparatively good crops, gave better results than those propagated in a similar manner from trees

of the same variety, growing under the same conditions but carrying only very poor crops.

The extremes and average number of fruits from each group of trees are shown on charts.

As the result of careful observations made since 1913, it is concluded that differences between trees of a variety such as the habit of carrying good and poor crops are not transmissible if vegetative propagation has been practised. Methods of selection have undoubtedly played a very important part in improvement of trees, but the hypothesis that bud selection from heavy croppers will result in progeny of similar habits, is invalid. The fact that such characteristics are not transmissible has also been confirmed as a result of recent research in other countries, and if propagation only from healthy trees is practised, grown under suitable conditions and upon well selected stocks, the trees will reproduce the original vigour and cropping powers of the variety.

M. L. Y.

207 Winter Pruning Experiments with Apple Trees in England.

GRUBB, N. H. in *The Journal of the Royal Horticultural Society*, Vol. XLVII, Pts. 2 and 3, pp 139-162, tables 5, plates 12. London, 1922.

An extensive series of experiments on the winter pruning of apple trees has been made at the East Malling Research Station, England, covering a period of 9 years (1913-22). The methods chosen for investigation were :

- 1) unpruned ; only diseased and broken wood removed ; ,
- 2) open centre ; centre of tree kept more or less bowl shaped, no spurring otherwise ;
- 3) tipped and spurred ; leaders tipped (strong growers one third ; medium growers one-half ; weak growers two-third) ; and all laterals not needed to form branches, spurred to three prominent buds ;
- 4) tipped and short-spurred ; laterals spurred to one prominent bud.

I. *Effect of tipping and spurring.* — Tipping appears always to delay or reduce blossoming at least until the biennial bearing habit reduces the number of blossom buds on untipped trees. The table showing the average number of buds per tree, unpruned and pruned gives ample evidence of this fact. The reverse is, however, the case as regards "setting" ; in this case pruning has obviously an indirect influence on the number of mature fruits. The average of all the varieties under observation in 1921 showed that the proportion that set on pruned trees may be estimated as double that on unpruned.

Effect on Cropping. — Except in the case of two varieties, tipping has delayed cropping. In these two cases ("Newton Wonder" and "Beauty of Bath") the trees were tipped one-third. The value of long-spur pruned trees has been proved ; in every case on an average of 3 years crops, the total weight of fruit has exceeded that from unpruned trees (about 30 %).

Effect on biennial bearing. — Tipping appears to check this habit, but a modification in pruning methods is required to reduce the amount of

blossom during the full-bearing year as it seems that profuse blossoming has more influence than heavy fruiting in encouraging the alternate bearing habit. It is suggested that if trees could be hard pruned and the spurs drastically shortened in the winter following their "off" year, and merely thinned out or lightly pruned the alternate winter, cropping should in time become more uniform.

Effect on growth and ultimate size of the tree. — The tipped trees of several varieties show an increase in size of head, more rapidly than unpruned trees, but no general rule can yet be laid down.

Effect on susceptibility to certain diseases. — Tipped trees are much less affected by scab (black spot), apple mildew, and common canker than unpruned trees. It remains yet to be seen whether this power of resistance should be attributed to a thicker cuticle or differences in structure of the tissues.

Effect of "Open centre" pruning. — The effects are similar to those of tipping, but much less marked. The setting of the blossom appears to be more complete than on unpruned trees; the fruit is larger and slightly freer from scab but the cropping varies according to variety. It is interesting to note that the stock seems to considerably influence the total number of fruits. The difference between the open centre and unpruned trees as regards resistance to disease is at present only very slightly in favour of the open centre.

Effect of short-spur pruning. — This always tends to reduce blossoming, at least up to the eighth year. In several cases however, setting has been more complete than on long-spur pruned trees and in a few cases have produced a larger total number of fruits. With some varieties (*e. g.* Cox's Orange and Lanes Prince Albert), the laterals die when short-spur pruned, leaving the wood bare. The Worcester Pearmain and James Grieve, are less seriously affected and Lord Derby and Gladstone show no trace of this effect.

Natural habit in relation to pruning. — It is essential to adapt methods of pruning to the habit of growth and fruiting of each variety; failure to do this often results in long-delayed cropping and heavy loss. The varieties under observation have been classified as follows:

very erect: Annie Elizabeth "Lord Derby" Worcester Pearmain;
moderately erect: James Gieves, Early Victoria, Cox's Orange, Rival;
intermediate: "Bismark", Grenadier, Newton Wonder;
moderately spreading: "Beauty of Bath", Gladstone (Bramley);
very spreading: Lanes Prince Albert, Allington, Norfolk Beauty.

Apart from the erectness, such habits as stoutness of branches, spur formation and number of laterals formed have an equally important bearing on pruning methods.

Those of the varieties requiring most tipping to encourage stouter branches etc. are "Allington", Lanes Prince Albert and Cox's Orange, and to a less extent "Derby" and Grenadier (the latter on account of its tip fruiting habit). The "Bismarck", Worcester and Newton Wonder" varieties require tipping to encourage spur formation. Certain varieties, however, require little if any tipping for permanent trees (*e. g.* Norfolk

Beauty, Bramley). As regards habit of fruiting, the varieties have been classified according to blossom bud formation, on an arbitrary basis:—terminals, axillaries, and spurs. The observations made with the varieties of unpruned trees indicate clearly the variations in habit. The "tip fruiting" of "Worcester Pearmain", Grenadier, Beauty of Bath, Gladstone and Norfolk Beauty is noticeable. This necessitates the leaving of the "long dards" (brindelles couronnées) on the young tree uncut whenever possible. It is considered that tipped and spurred trees as a whole, produce a much larger proportion of axillary fruit buds than when left unpruned. The change in natural habit of a variety both in growth or fruiting due to local conditions of soil or climate is apparently limited to shortening or lengthening of the parts rather than to any radical change in habit.

In conclusion, the importance of studying the differences in the habit of varieties is emphasised, making allowances when pruning for differences in growth and other details. M. L. Y.

208 Cultivation of Apple and Citrous Fruits in Chile.

I. BISQUERTT, J. T. Variedades de manzano que más nos conviene cultivar. *Boletín de la Sociedad Nacional de Agricultura*, Vol LIII, No 7, pp. 400-402 Santiago de Chile, 1922.

IDEM Variedades de naranjos más convenientes al país, *Ibidem*, p. 402-407.

I. — The inhabitants of Chile prefer the sweet apple such as the "Huidobro", the most common variety grown and practically the only one cultivated to Santiago from the Huasco valley. Other varieties grown in this region ("Hoover", "Northern Spy") lose to a great extent their acid flavour and become soft and pithy and do not keep well. The cultivation of the apple from the standpoint of export value should succeed best in southern Chile.

According to the author (Professor of Arboriculture at the "Instituto Agronómico" of Santiago), the most suitable varieties should be selected from the most popular American species "Winesap", "Jonathan", "Rome Beauty", Spitzenberg, "Yellow Newton", Delicious", (the last mentioned is very popular on the Buenos Aires market) (1).

A technical commission has been appointed by the Chile Government in the United States to study the cultivation of fruit trees also from the commercial and industrial standpoints.

II — For several years the oranges in Chile have been propagated by seed and consequently a mixture of various types exists which lack specific characteristics, and the fruit is merely called after the locality in which it is grown e.g. Naltagua, Tunca, Peumo, etc.

The author suggests a scheme for the scientific cultivation of the orange

(1. A certain section of the market in Buenos Aires is devoted entirely to Chile apples. The most popular varieties are "Hoover", "Reineta".

MONSERRAT, R. Exportación de manzanas chilenas a la República Argentina. *Boletín de la Sociedad Nacional de Agricultura*, Vol LIII, No 7, pp 393-400 Santiago, 1922 (Ed.)

tree and recommends propagation by grafting on the following stocks : "Mejorada de Thompson" Washington Navel, Golden Navel, Navalencia (this has been grown successfully in the orange groves at El Salto) and those with a thin skin (preferred in Chile); San Miguel (ripens late and stays a long time on the tree), San Miguel de Azores (early) and the Malta, blood orange and Mediterranean, and Jaffa orange, etc. F. D.

209. Fruit-Growing in Brazil.

DA COSTA, J. S. Pomicultura tropical. Rio de Janeiro. Emp. Ind. 51 pp., Editor "O. Norte", 1922.

The author points out that the fruit growing industry might be greatly developed in Brazil and become a source of considerable wealth on account of the large variety of fruit-bearing trees that flourish in the country, and its fortunate geographical position enables products to be sent to the European and North American markets from November to March, during the season when fresh fruit of local production is very scarce.

Until recently, Brazil has entirely neglected this potential source of income, indeed in 1920, she only exported 199 694 000 oranges; 426 kg. of table-fruit, 505 300 kg. of pine-apples and 2 618 210 bunches of bananas of which the total value was 2 539 365 *milreis*, whereas the imports amounted to 1 548 000 kg. of dried fruit, 1 269 000 kg. of apples, 1 047 000 of grapes, 859 000 kg. of chestnuts, 717 000 kg. of pears etc., the total quantity being 7 353 000 kg., and the value 14 732 000 *milreis*.

The object of the author is to make generally known the main facts respecting the cultivation and characteristics of the chief fruit-trees of tropical climates; he bases his observations to a great extent upon his own knowledge and experience. He deals briefly with the various methods of propagating fruit-trees; the preparation of the soil; planting and cultural operations; he also gives a description of the various fruit-trees grown in Brazil, and devotes the last chapter to the cryptogamic parasites and the means of control.

The following species are to be recommended for industrial cultivation: the avocado (*Persea gratissima*), a native of Brazil, where it reaches the height of 15 m. in the fifth year after sowing, and begins to bear when 5 or 6 years old. In the extreme north of Brazil, this tree produces two crops annually, and a fine specimen yields 600 to 700 fruits a year from its seventh year. The fruits can be kept in cold storage for over 30 days.

"Abin" (*Lucum cainito*), one of the most valuable fruits of the Amazon district. The tree is propagated by seeds, or slips. In North Brazil it begins bearing at the third year and is in full bearing at the seventh. There are 4 varieties in Pará; two with roundish fruits (those of the one variety being half the size of those of the other) and two with oval fruits (of the same size as the large round ones in the first case and twice the size in the second). The smaller fruits invariably have the finer flavour. The tree can be grown from the Amazon district to Rio Janeiro where many specimens are already found. The fruits can stand the Trans-

Atlantic voyage if put in cold storage. "Abrico" (*Mammea americana*) indigenous in Pará (according to some authorities also in the Antilles), where it attains the height of 30 m. The tree is not exacting in its requirements, is immune from disease and very resistant to winds. In addition to fruit, it yields a fine wood for cabinet-making and a scent ("eau de créole") is made from its flowers. "Ananaz", or "abacaxi", a wild pine-apple growing in the Brazilian forests of the tropical zone, can be cultivated from Pernambuco to São Paulo and has many excellent varieties. These fruits are frequently gathered before they are ripe, and in consequence, although they develop colour and flavour in transit they remain sour. The ripe pineapples can be kept in cold storage for 45 days.

"Anonas". A large number of *Anonaceae* are native to Brazil, others although indigenous in other parts of Central and South America have become perfectly acclimatised there. Amongst these are the "graviola" (*Anona muricata*) a native of the Antilles, and *A. cherimollia* indigenous in Ecuador and Peru. Some trees of the latter species grow in the State of Rio Janeiro, in Ilha do Vianna. In North Brazil, *A. palustris* ("areticum" or "coração da Índia", bullock's heart in English) grows wild, but owing to its disagreeable odour and its flavour which is not acceptable to the European palate, this tree is not worth cultivating. "Araca" (*Feijoa sellowiana*) indigenous in Brazil; begins bearing at the second year, produces a fairly hard wood in addition to fruit.

"Bacuri" (*Platonia insignis*). Wild and of common occurrence in the forests of the Amazon, Maranhão, and Piahy; is cultivated in Belém. This tree grows rapidly to a height of 30-35 m. and comes into full bearing after its tenth year. It is very ornamental on account of its fine foliage and many flowers which closely resemble camelias. The fruit has a very persistent flavour and is largely used for confectionary and jellies.

Banana (*Musa sapientum*). This is perfectly acclimatised in Brazil. In the State of Rio do Janeiro, it begins to bear at the age of 18 months, and in North Brazil before the 12th month. The earliest fruits are the sweetest and most valuable. By means of manuring this tree can be kept in bearing until its tenth year. Several varieties are cultivated, the "branca" maçã and "couro" kinds have such thin skins as to be useless for export. "Gros Michel" and *M. cavendishi*, owing to the thick skins of their fruit, produce the only bananas fit for export.

If however, refrigerating-cars were available, even the most delicate fruits could stand travelling.

The "San Thomé banana" and the "banana da terra" a variety of *M. paradisiaca* are also cultivated.

Biriba (*Rollinia orthopetala*), also called "fructa da condessa" or "ata", is indigenous in Brazil and grows throughout the country.

"Cajú" (*Anacardium occidentale*), is wild every where in Brazil, and attains enormous dimensions in the Amazon region. The fruits have valuable medicinal properties; a beverage called "cajuada", and a wine renowned for its flavour and therapeutic (aperient) qualities are

made from the juice, while the pulp after pressing can be dried, or used for jam.

The seeds in the fruits are either eaten in their natural condition, per employed in confectionery. The fruit-skins furnish a very caustic oil and an indelible ink. On making an incision into the cortex of the tree a resin is obtained that forms an excellent insecticide and is also used for many industrial purposes. This tree can be raised from seed, in the Piauhry district, fruit is borne 1 year after sowing.

"Carambola" (*Averroa carambola*), acclimatised throughout all tropical Brazil. Begins bearing at the third year.

"Cupù assù" (*Theobroma grandiflora*), of little, or no use for making chocolate, but its fruits are excellent for sherbert. Grows wild in the Amazon district and is cultivated in the neighbourhood of Belem (Parà); can be acclimatised everywhere in Brazil. This plant, however, seems to have introduced into Dutch Guiana a serious disease of the cacao known as "Krulloten" (1), therefore the author recommends that caution should be used when extending its cultivation.

"Cutiriba" (*Lucuma rivica*) and "cutiriba grande" (*L. macrocarpa*) indigenous in the Amazon region.

"Figo" (*Ficus* spp.). *F. carica* does well throughout Brazil, but in the Federal district, especially in the dampest parts, it is much subject to the attacks of a moth the larva of which perforates the roots and takes up its abode in them.

"Fructa pão" (*Arctocarpus incisa*). Perfectly acclimatised in Brazil from the extreme north to São Paulo. *A. nobilis* has also become well acclimatised in the northern part of the country. Its seeds are eaten cooked, by the Indians. The author does not however advise its propagation.

"Genipapo" (*Genipa americana*). Wild from the Amazon to Rio Janeiro. Bears fruits that are delicious when cooked and sweetened and an extract of reputed properties as a stomachic is made from them.

"Goiaba" (*Psidium guajava*). A native of tropical America, where there are many varieties, some shrub-like and others growing to the height of 10 m. A delicious jelly is manufactured from the fruits which might become the basis of an important industry if it could be made known abroad. This plant is easily grown from seed and begins bearing the second, or even the first year.

"Jaca" (*Arctocarpus integrifolia*). Introduced into Brazil by the Portuguese and now completely acclimatised, produces fruits weighing up to 50 kg. "Jaca" is much grown in the State of Bahia, but its fruits when green have an unpleasant smell which becomes almost unbearable as soon as they are ripe.

"Kaki" (*Diospyros kaki*). Does well in Brazil where its fruits command very high prices.

"Laranjas" (Oranges) and other citrus fruits grow exceedingly well in Brazil. The orange-tree also grows in the Amazon region, but the

(1) *Marasmius perniciosus*, See R. 1920, No. 35. (Ed.)

fruit is sweeter and more juicy in the cooler and damper parts. In the interior of Maranhão and of Piauí, orange-trees grow to a large size and produce an abundance of luscious fruit. The Bahia orange is widely known, as is also the "laranja selecta" of Rio de Janeiro. The following varieties of orange are cultivated in Brazil: the Bahia orange — China orange — round orange — "laranja lima" almost without acidity — "laranja azeda", or "laranja de terra" (Seville orange) etc., all these kinds have delicious fruit. In addition to the orange are cultivated: the Japanese mandarin orange (*Citrus nobilis*), the "toranja" (*C. grandis*) bergamot, citrus, lemon (*C. limonia*) called "limão gallego" and *C. aurantifolia* or "limão comun", which is more or less common throughout Brazil.

The lemons are used only for local consumption. The citrus trees are propagated from seed; the author recommends grafting on "laranja de terra". "Mamao" (*Carica Papaya*) grows wild in the forest in Florida and in the interior of Brazil. In the latter country it assumes various forms; the author therefore advises that the best kinds should be propagated by grafting. The fruits are not suited for packing, but papain can be prepared from them and exported.

"Manga" (Mango, *Mangifera indica*). This tree produces excellent fruit sold at very high prices in the State of Rio de Janeiro.

"Mangabeira" (*Hancornia speciosa*) found wild in the forests throughout Brazil, from the extreme north to the centre of the State of São Paulo. The latex extracted from the Pará variety called "Mancornia Amapá" has been successfully employed in cases of pulmonary weakness. The fruits are much used for jam.

"Mangustan" (*Garcinia Mangostana*) would thrive in tropical Brazil, especially in the States of Pará and Maranhão.

"Maracuja" (*Passiflora laurifolia*, *P. edulis*, *P. quadrangularis* etc.). In north Brazil there are numerous species and varieties of this tree. The fruits can be kept in cold storage for 3 months.

"Sapota", "sapoti", sapodila (*Achras sapota*). Wild in Brazil; in the Northern States it grows to an enormous size. Four varieties can be distinguished of which the best is that known as "sapota". Some trees bear at the same time, fruits varying greatly in shape, colour, size and flavour. The fruits cannot be kept in cold storage, for they never ripen properly after this treatment; if however, they are gathered when quite ripe and carefully packed in cases in single rows and kept in well ventilated places they stand long journeys and storage. They could be most profitably grown in the states of Pará and of Maranhão.

"Uchy" (*Sacoglottis Uchy*). The acid fruits of this tree are liked in Pará.

Vines. It is not advisable to cultivate European varieties, as the climate would be too hot and damp, the cultivation and selection of American varieties might however be attempted (1).

(1) See No. 213 of this Review: HERVÉ, *Viticultura ed enologia nel Rio Grande do Sul*. (Ed.)

The author mentions several other Brazilian fruit-trees but does not recommend that they should be grown on a large scale for export, these are: "Sorva" (*Couma guyanensis*), "Sorva grande" (*C. utilis*), "pitomba" (*Talicea esculenta*) "cambucà" (*Melastoma tomentosa*) etc.

F. D.

210. Poisonous Metals on Sprayed Fruits and Vegetables.

LYNCH, W. D (Assistant Chemist), McDONNELL, (Chief, Insecticide and Fungicide Laboratory), HAYWOOD, J. K (Chief, Miscellaneous Division. Bureau of Chemistry), QUAINANCE, A. L. (Entomologist, Fruit Investigations, Bureau of Entomology), WAITT, M. B (Pathologist, Fruit Disease Investigations, Bureau of Plant Industry) U. S. Department of Agriculture, *Bulletin* No. 1027, pp 66, bibliography. Washington, 1922.

Study undertaken to ascertain the amounts of arsenic, lead and copper remaining on fruits and vegetables treated with poisonous sprays.

Results of previous investigations are given, followed by a description of the experiments made with peaches, cherries, plums, apples, pears, grapes, cranberries, tomatoes, celery, and cucumbers. Various methods of analysis were employed.

The following general conclusions may be drawn:

Comparatively large quantities of spray residues were found only when sprayed to excess, or in the case of late sprayings. In one instance 0.13 % of lead was found on apples (dried fruit). The poison is liable to accumulate in the calyx. This indicates the importance of strictly adhering to the regulations recommended by the Bureaus of Entomology and Plant Industry. Practically all of the spray residues can be removed by peeling the fruit.

L. V.

Vine growing.

211. New Systems of Pruning Vines adopted in Emilia.

NANARESÌ, A, Un nuovo sistema di potatura della vite. *Giornale d' Agricoltura*, Year 59, No 11, pp. 384-388, 4 figs., Placentia, 1922.

The system of rearing supports and vines in the Province of Bologna is of two types:—

a) In the Imola district the trunk of the support (almost always a maple) is 1.2 m. — 1.5 m. high and bears two main branches perpendicular to the row of trees, which bifurcate at a certain height so that the crowning foliage is borne by 4 supporting branches or "cavassi". The stem of the vine ascends the trunk and the one year old shoots are tied at various heights on the "cavassi" and "stretched" until the next tree is reached, or the vine branches which come from it to form the "tirelle" or "tralciaie".

The vine branches are trained close to each other horizontally. The trees are spaced 4.5—5.5 m. from each other.

b) In almost all the rest of the Province the trunk of the supports (almost always elms) 1.8—4.2 m high bears two main branches forming

a V in the vertical plane of the row of trees. The branches of the vine are tied at various heights along the "cavassi", then inclined somewhat downwards and led up to the trunk of the next tree. Often some are left hanging or are tied to a wire joining two adjacent trees as in the Modena-Reggio system. The vine branches, differing from the previous case, are arranged one below another.

Latterly the greatly increased cost of production has rendered it necessary to increase the crop even if the quality be somewhat lowered; owing to the fertility of the soil, the vitality of the vines does not apparently suffer to any extent.

a) One of the first improvements which were started some twenty years ago consists in the transformation of the annual "tirelle" into permanent "tirelle", pruning the latter as a Cazenave-Marcon "cordone". Not only more abundant but also more regular fruiting is thus obtained. A certain number of 2 bud spurs are left on the vine branches, of the resulting shoots, the lower is again cut with a spur and the upper one with 4-6 buds as in the Guyot system.

When the "cordoni" commence to be exhausted they are renewed by making use of shoots cut off at the base of the "tirella" itself or off one of the adjacent "cursorelli".

The renewal of the various "tirelle" of the same vine is done gradually, consequently without injury to regular fruiting.

b) In another improvement part of the vine branches of the "tirelle", cut at about two metres is arranged as "pergolati pensile" or "bilance", on one or both sides of the row of trees; the vine branches are tied on strong rods of wood or iron, 1.5-4 m long, which are supported at one end on the shoulder of the tree, while the other end is held up by a tie-rod. A rod is placed for every 3 or 4 trees. All the ends are then connected by a wire to which the fruitful vine branches are tied, sometimes renewed yearly, sometimes made permanent in the form of spurred "cordoni". In this way yields of 50 kg or more of grapes per tree are obtained. Drawback.—intense shading of the ground.

c) During the last few years another improvement has been introduced in the level part of the Province— the vines are trained in vertical instead of horizontal planes; the branches of the supporting trees, in V form, are prolonged above them, numerous "tirelle" almost always consisting of one year old vine branches are stretched horizontally and reach to a height of 5 or 6 metres.

d) The system which the author considers more scientific and to be recommended is that of "a filonate" invented and used since 1918, by the brothers BERGONZONI on the Crocetta property (S. Agata Bolognese).

The rows of vines to which it was applied were supported by elms, black poplars, mulberry trees, etc. about 4 m. apart which had near them from one to four vines. The trees were reduced to single stems, about 6 metres high with limited foliage. At 1.3-1.4 m from the ground, 4 or 5 thick galvanised iron wires (Size No. 18 to 20) 80-85 cm. apart were stretched horizontally. To these were tied the vine branches in such a way that, after 2 or 3 years, transformed into permanent "cordoni", they would

occupy the space between two trees. Then half or two thirds of the supporting trees were sawn at ground level, being replaced by posts about 6 m. high fixed to the ground by two supports. Each "cordone" is about 4 m. long and furnished with 10-18 "cursoncelli" according to the vigor and the variety of vine. Each "cursoncello" bears a 2 bud spur and a grape-bearing branch 5-6 buds long.

When the system was applied to new planting, poplars were used at intervals of 8 m. and 6-8 vines to each interval, both grown until sufficiently strong to set up posts and iron wires and form permanent spurred "cordoni".

The BERGONZONI system is rapidly extending even outside the Province. F. D.

212 Table Grapes recommended for Cultivation in Italy (1)

I. — SANNINO, F. A. Uve da tavola precoci: Madeleine royale *Rivista di Ampelografia*, Year III, No. 10, pp. 151-152 Alba, 1922

II — IDEM Pansè precoce *Ibidem*, No 11, pp 171-172, 1922.

III — CASELLA, D, La "Madeleine Angevine" *L'Italia agricola*, Year 59, No 11, pp 389-391, 2 fig, 1 table Placentia, 1922.

I — The more noted early grapes are few and among them the "Madeleine royale" stands first. Owing to its earliness and fertility the writer recommends that it should be grown especially in Northern Italy where the local early grapes are reduced to the "Luglienga" and the "Agostenga". At Alba (Province of Cuneo) it ripens early in August and, owing to the scarcity of rain at that season, keeps well on the vine. It is rich in sugar (21.63 %, acidity, as tartaric acid 3.37 %), owing to which it can also be used for making wine, the lack of acidity being corrected by the addition of tartaric and citric acids.

The cultivation of the "Madeleine royale" may also be recommended for warm countries, the more so because it can be pruned short, with spurs, against walls, with the three-fold advantage of increasing the volume of the bunches, the amount of sugar and the earliness of ripening.

II. — The author describes the "Pansè precoce" or "Sicilien" del PELLICOR found in the ROVASENDA at the Alba "Scuola di Viticoltura ed Enologia". The grape, of a fine golden colour, ripens in August and is liable to rot if gathering is delayed. The side shoots are fertile and the second crop of clusters will ripen early, but it is better to suppress them in favour of the ordinary clusters. Grapes gathered at Alba in 1922 gave:— sugar 18.74 %, total acidity 4.50 %.

III. — The "Madeleine Angevine" is considered as a hybrid of the "Madeleine Royale" with the "Malingre précoce." Advantages:— grafts well with most of the American root stocks; vigour, productivity; earliness; good quality grape with thin skin and stands transport. The vine bears clusters from the second node and can therefore be subjected, in Southern Italy, to short pruning and especially to spurred "cordone."

(1) See B. 1922. No 437. (Ed)

It has the defect of becoming subject to "colatura" and to abortive flowering. This is chiefly due, as the author has found, to sterility of the pollen; he has also found that this vine is mainly wind-fertilized. Consequently to avoid the above-mentioned defect, it should be grown mixed with a few good pollen producing vines flowering at the same time, such as Riparia and Aramon \times Rupestris Ganzin N^o 1. F. D.

213, Vine-Growing and Wine-Making in Rio Grande do Sul.

HERVE, E (Director do Instituto de Agronomia "Dr Borges de Medeiros" Porto Alegre). A viticultura e vincultura no Rio Grande do Sul. *A Federação*, Year XXXIX, Na 194; 196; 202; 227 Porto Alegre, 1922.

Vine-growing was introduced into the State of Rio Grande do Sul, by the European immigrants who planted the Isabella variety which is hardy and easily cultivated.

The "Estação Agronomica do Estado", on its foundation undertook the improvement of the technical cultivation of the vine and the extension of vinegrowing, and the "Laboratorio de Analyzes do Estado" supervised the quality of all exported wines and the instruction of the vine-growers in the art of wine-making.

At the present time (1922), there are other analytical laboratories in the State of Rio Grande do Sul, viz. at Caxias, Bento Gonçalves, S. João do Montenegro, Rio Grande etc. where the same work is carried out.

The "Instituto Borges de Medeiros", to which is attached the State Agricultural Station, has imported American vines (Riparia, *Riparia* \times *Rupestris*, *Rupestris du Lot*) and several European species, as well as introducing scions from Montevideo, but owing to the long journey and change of climate only a few of the plants took root and these did not grow strongly.

The stocks and various European vines having become acclimatised, the systematic plantation of vines for furnishing scions to agriculturists was begun in 1920. The experiments hitherto made have clearly proved that vine-growing can develop greatly in the State and that good wines can be produced.

The amount of wine exported rose from 8754 hectolitres in 1914 to 29 871 hectolitres, in 1920, with a corresponding improvement in quality. Since 1906 no colouring matter has been introduced into the wines, further, from that date, instead of the Isabella variety alone being planted, many other wines such as Barbera, Malbec, Peverella, Malvasia etc., have been cultivated. The author insists on the advisability of gradually abandoning the cultivation of the Isabella variety which has little power of resistance and produces grapes of very inferior quality.

Owing to the hot damp climate, which is favourable both to cryptogamic diseases and insect parasites, it is necessary to breed resistant varieties of vines and adopt a suitable system of cultivation.

The chief vine-growing district of the State is situated within the territory of the Italian colonies: Caxias, Bento Gonçalves, Alfredo Chaves etc., and in the neighbourhood of Porto Alegre, where the soil is derived

from basalt and in consequence is deficient in lime and phosphorus, so that the addition of fertilisers is most advantageous.

One hectare planted with 600 to 900 Isabella vine stocks produces on an average 220 quintals of grapes, which corresponds to 150 hectolitres of must and 110 hectolitres of wine. European vines (Souzão, Barbera, Malbec and Rhenish Riesling), planted in rows at the rate of 1800-2000 stocks per hectare, produce on an average, when in full bearing, 90 quintals of grapes per hectare, corresponding to 67 hectolitres of must and 50 hectolitres of wine. Isabella wine sells at about one third of the price of wine made from the grapes of European vines, therefore it pays better to grow the latter of which the best kinds are capable of bearing still larger crops, and of producing fine table-fruit. The grapes of best quality sell for 8 *milreis* per kg. (1 *milreis* = about 2s. 3d. at par) on the market of Rio di Janeiro.

The wine scientifically manufactured at the "Instituto Borges de Medeiros" from Suzão and Merlot grapes contains 1.11 % of alcohol and 1.8 % total acidity.

F. D.

Forestry.

214. Bear Clover and Forest Reproduction.

MUNNS, E N (Forest Examiner, U. S. Forest Service) Bear Clover and Forest Reproduction *Journal of Forestry*, Vol. XX, No 7, pp 745-754, 3 figs., 4 tables Washington, D C, 1922

Some observations were made on this subject in 1911, 1915 and 1921 in the Stanislaus Forest. But it would be unwise to draw too general conclusions from them. That forest was burnt during the summer of 1911. Previously the forest had, besides isolated bushes of "Bear Clover" some denser spots. These spots are attributed to a fire which occurred in 1902. Two areas of $\frac{1}{2}$ ha. escaped. They are situated in the yellow pine (*Pinus echinata*) zone in which some cedars (*Libocedrus decurrens*) and firs (*Abies concolor*) are found.

Evolution of the Bear Clover. — The "Bear Clover" or "Eraweed" (*Chamaebatia foliolosa*) is a small prickly bush belonging to the Rosaceae. It does not exceed 0.45 m. in height but may be much branched. It has numerous underground rhizomes which give off aerial branches here and there. The numerous roots of this system drain the moisture from the soil which it occupies, and to give some idea of its magnitude it may be mentioned that an underground rhizome has been followed up for over 29 metres, that some rhizomes are buried to a depth of 0.20 m. and send out roots to a depth of 1.50 m. Lastly, "Bear Clover" has hard seeds which can await favourable conditions for germination. The absence of "Bear Clover" in certain places has been attributed to the dryness of the soil caused by plants already occupying the ground and to the density of the shade which hinders chlorophyll assimilation. These two causes have an influence, but the real cause is the existence of a thick dead layer which

has a physical and a chemical action. This is proved by the fact that in forests which have escaped fire for a long time only isolated specimens of the species are found. On the other hand it is very common on recently burnt areas and in places where the dead layer has been removed. This dead layer sometimes attains a thickness of 0.20 m. in pine forests and is then impenetrable by the "Bear Clover" shoots. If a bushy fire occurs, it burns that layer and the surface growth. Moreover the heat and gases from the fire injure the lower branches of the trees, which increases the fall of needles and forms a thick carpet in the following spring. "Bear Clover" takes 5 years to renew its growth by seed or its rhizomes. During this period the dead layer is reconstituted and again prevents growth, but, if a fresh bush fire occurs the "Bear Clover" is then able to get through the layer. Chemically, the dead layer causes an acid reaction in the soil which kills underground vegetation, or at least checks it.

According to the density of the "Bear Clover" land is classed —
 Very overgrown — more than 440 stems per square metre
 Interspersed — 55 to 440 stems per square metre
 Free : — Less than 55 stems

"Bear Clover" is so encroaching that, if the conditions favour it, "free" places soon become "interspersed" and then "very overgrown".

Injurious effect of "Bear Clover" in nurseries and on the growth of trees. — In the nurseries results have only been obtained in places where "Bear Clover" is non-existent or is of negligible importance. Thus from 1911 to 1915, 92.9 % of successes have been obtained on soils free, or almost so, "of Bear Clover". This percentage rose to 99.6 % during the period 1916 to 1921.

Two neighbouring and similar nurseries were compared in 1921, but one was free from "Bear Clover" the other was invaded by it. Observations were begun in May. In November, only 6.5 % of the yellow pine (*Pinus echinata*) survived in the "Bear Clover" zone and 30.3 % in the "free" zone. Of the firs (*Abies concolor*) all had died in one case, 28.5 % survived in the other. The contrary effect was noted in the case of cedars (*Libocedrus decurrens*), 16.4 % of them survived in the free zone, 27.9 % in the other. This characteristic of the cedar is moreover confirmed by the fact that in places infested with "Bear Clover" that tree is the commonest. This is due to its root system which is extremely branched. The white fir, similarly, stands "Bear Clover" owing to its abundant superficial roots. But this property requires a moist summer for good growth. To investigate the reduction in growth of trees caused by "Bear Clover", comparative studies were made in infested and non-infested places. The presence of "Bear Clover" increased by 112 % the time taken by *Pinus echinata* to reach a diameter of 1.40 m. The percentages ascertained for *Libocedrus decurrens* and *Abies concolor* were 52 % and 42 % respectively.

When it is considered that the rotation adopted for the exploitation of pine and fir forests is 75 years, it is evident how disastrous any cause which reduces the rate of growth of the trees must be.

R. D

215 Hazel Woods in Forestry and the Undergrowth.

SAVA, S. Il nocciolo nella selvicoltura ed i sottoprodotti del bosco. *Le Stazioni sperimentali agrarie italiane*, Vol. LV, Pts 7-8-9, pp. 278-291. Modena, 1922

The author recommends the planting of hazels (*Corylus Avellana*), for firewood. Apart from the finer varieties, which grow best on light soils, the hardier varieties are recommended, especially those noted for superior wood rather than for fruits: *C. sylvestris*, *C. tubulosa*, *C. glandulosa*. The cutting may take place after 10 years growth.

In the case of mountain woodlands, it is recommended to plant with hazels only, or intermingled with tall, well developed trees, such as chestnuts and oaks, which are easily recognisable.

As regards the undergrowth, the introduction of hazels may serve several useful purposes: — the long and flexible young twigs are suitable material for basket making; the leaves as forage, while fungi (*Psalliota campestris*, *Amanita cesarea*, *Boletus edulis*) and truffles make excellent growth when basic slag or phosphates are used. F. D.

216. Afforestation in Korea.

ROXBY PERCY, M. *The Scottish Geographical Magazine*, Vol XXXIX, No 1, pp 3-6, 2 fig Edinburgh, 1923

The Japanese have undertaken systematic afforestation in Korea. This large undertaking was facilitated by the following facts:—

After conquest in 1910, the Japanese Government, in succession to the Korean Royal House, became owner of seven eighths of the region of "Hills and Mountains" (15 400 000 ha out of 17 600 000 ha) which covers almost the whole of Korea. This granitic area, formerly rich in forest, was deforested to the detriment of agricultural prosperity. The only part which remained under forest is situated in the North East in the upper basin of the Yalu and extends in a Northerly direction towards the Amur. The destruction of this forest has been attempted on the Manchurian side. But the Japanese have established a station at Shingishu which controls the working of the forest. They restrict exploitation to $\frac{1}{20}$ of the area yearly and require compensating re-afforestation. At the same time re-afforestation is strenuously proceeded with in the denuded mountains of the Centre and South of the peninsula, where 275 000 ha. have already been re-afforested, half by the Administration and half by private persons. After 10 years the latter will become owners of the land which they have afforested, if the Administration is satisfied with their work. At present plantation progresses at the rate of 150 000 000 trees per year, 3000 to 5000 trees being planted per ha. The hills are mainly planted with Korean pine (*Pinus Koreanensis*) which become full grown at 40 years, and then attain a height of 18 metres. But these trees have to be protected from the country people who exploit them for their requirements. Consequently, large plantations of quick-growing trees, such as black poplar (*Populus nigra*) have been made in the valleys for their use. Out of the 15 400 000 ha.

which are to be afforested the Government intends to keep 6 600 000 as national property. The remainder will pass into the possession of private owners.

The Japanese experts expect the following results from re-afforestation.

1. — Improvement of the climate : (a) the trees will act as a wind-screen ; (b) the temperature will be regulated ; (c) a slight increase in the rainfall.

2. — Decrease in the extent of floods, which will directly benefit agriculture. There will also result from it :—

3. — The possibility of establishing reservoirs for irrigation.

4. — Increase in pastures, and consequently of cattle. Development of the value of the rivers in fish.

5. — Purification of the air and increase in the beauty of the country.

The accomplishment of this work costs the Japanese Government 3 500 000 *yen* a year (1 *yen* = 24.58 frs.). In order to attract public attention to the work, "Arbor Day" has been appointed a national holiday in Japan.

R. D.

BIBLIOGRAPHICAL NOTES.

- 217 HARLAN, H. V., POPE, M. N., and AICHER, L. C. Trebi Barley, a Superior Variety for Irrigated Land *United States Department of Agriculture, Department Circular* 208, pp 1-8 Washington, D C, 1922.

Report of the experiments made in Idaho (U. S.) with the new pure-line variety Trebi barley, descended originally from a single plant on the southern border of the Black Sea. Results indicate that it is of decided value on irrigated land, but is not suitable for non-irrigated districts.

M. L. Y.

218. YODER P. A. (Sugar-Cane Technologist) Growing Sugar Cane For Sirup — *U. S. Dept of Agriculture, Bureau of Plant Industry, in Farmers' Bulletin* N. 1034, pp. 36, plates 14, bibliography Washington, D C 1922

The writer draws attention to the fact that sugar-cane growing for sirup is at present essentially a small-farm enterprise, in contrast to the sugar cane industry in general, in which sugar is the main product. The article is illustrated and gives detailed instructions for the cultivation, growing and harvesting of the crop, and draws attention to the climatic, soil and fertiliser requirements. The best varieties of cane are mentioned together with a list of the qualities which should be possessed by a good variety. Diseases and pests are described and means of control suggested.

The cost of a small outfit is given and the labour requirements per acre of cane, and the article concludes with suggestions for the utilisation of by-products.

W. S. G.

- 219 VIEIRA NOVO, A. Asamêdoas. *Broteria, Serie de Vulgarização Scientifica*, Vol III, Part I, pp. 10-16 Braga, 1923.

This article contains an account of almond growing and trade in the chief countries of production, and especially in Spain. Some information is also given respecting almond production in Portugal. The principal centre of this industry in the latter country is the Province of Algarve. In 1919, 784 459 kg. of unshelled almonds and 1 526 627 kg. of shelled almonds were exported from Portugal, as against 779 790 and 1 502 048 respectively in 1913. In years of greater production when the export trade is more active, almonds fetch higher prices. F. D.

- 220 MARCHINI, A, Varietà di olivo nell'Umbria Le caratteristiche delle varietà "Moraiolo" *L'Italia agricola*, Year 59, No 11, pp 392-399, 7 figs Placentia, 1922

Description of the "Moraiolo" variety of olive, which begins a series of similar papers on the other varieties and which is in continuation of the memoir:— A MARCHINI, Varietà di olivo nell'Umbria Contribution to research on the relation between the characters of the variety and the geo-agricultural conditions. Pinerolo. 1921. F. D.

- 221 CHAPMAN, H H, A new hybrid pine (*Pinus palustris* × *Pinus talda*) *Journal of Forestry*, Vol XX, No 7, pp 729-734, 3 figs Washington, D. C., 1922

The existence of a hybrid pine (*Pinus palustris* × *Pinus talda*) has been proved. The article describes the pine and shows that morphologically and physiologically it is intermediate between the two pure species. It is of great interest for the afforestation of denuded areas in the United States. *Pinus palustris*, which stands drought is suitable for these regions. But it must be discarded on account of its slow growth, in favour of the hybrid which, owing to the influence of *Pinus talda*, has not this drawback. A. D.

- 222 MARROQUIM, A Descripción del estado de Alagoas (Brasil) *Terra das Alagoas* Part 4, pp 400 + figs. 27 plates + map Rome, 1922.

The following chapters are included: — history (from discovery to the present time); physical geography, administration; political situation; industries; farming and sugar industry literature and fine arts. The chapter reserved for agriculture (20 pages) describes the crops cultivated in the State. The actual data are not available, as the agricultural statistical department is not yet organised. Conditions are suitable for various crops, the chief being the sugar cane and cotton. The 1920 census records the following figures with reference to live stock: 360 000 cattle, 76 000 horses, 12 000 donkeys and mules, 77 000 pigs, 146 000 sheep, 190 000 goats (in round figures). The "Aprendizado de Satuba" founded in 1912 is responsible for agricultural instruction (intermediate 2 years course). The sugar production in 1920-1921 amounted to 154 000 sacks of 60 kg. F. D.

LIVE STOCK AND BREEDING.

SYNTHETIC ARTICLES

223 Studies on Swine Feeding.

I — SPÖRTEL, W and TÄNGER, E, Über Kalk und Phosphorsäure Bedarf und Fütterung beim Schwein *Zeitschrift für Schweinezeitung*, Part 10, pp 145-152; Part. 11, pp. 164-166 Neudamm, 1922.

II — MÜLLER and RICHTER, Weideversuch mit Lauferschweinen auf Rieselgras mit verschiedenen Beifuttergaben *Ibidem*, Part 19, pp. 296-299, 1922

III — MÜLLER and SANDBRINK, Mastversuch mit verschiedenen Eiweiss, futter *Deutsche Landwirtschaftliche Presse*, Year 49, No 40, pp. 276 Berlin-1922

IV — THOMPSON, J I and VOORHIES, E C, Hog-Feeding Experiments. *College of Agriculture, Agricultural Experiment Station, Berkeley, California, Bulletin* No 342, pp 375-396 Berkeley, 1922

V — STARKFY, L. V, and SAIMON, W D, Rations for Weaning Pigs *South Carolina Experiment Station of Clemson Agricultural College Bulletin*, 213, 8 pp Clemson College, 1922.

I THE AMOUNT OF CALCIUM AND OF PHOSPHORUS ANHYDRIDE NECESSARY FOR SWINE, AND TO BE INCLUDED IN THEIR RATIONS — The authors give a detailed account of all that is at present known on this subject, and of the experiments which have been made. It appears that the addition of organic and in-organic calcium compounds is necessary when the natural food of the animals is deficient in these substances which not only promote skeletal growth, but also metabolism and the constructive processes. If the rations contain sufficient calcium, no more need be added.

II. SWINE-FEEDING TEST IN IRRIGATED MEADOW WITH VARIOUS SUPPLEMENTARY RATIONS. — Experiments carried out at the Versuchswirtschaft für Schweinehaltung, Fütterung und Zucht at Ruhlsdorf, Kreis Teltow (Germany) to ascertain: 1) whether 5 hours of grazing are sufficient, or whether 6 hours are needed; 2) how much concentrated food must be given to pigs at grass. Fifty-four pigs were divided into 4 groups and each group was subdivided into 2 sub-groups for the experiment. The animals of the first group were 6 months old and their initial weight (on July 15, 1922), was 67.5 kg.; those of the second were 3 ½ months old and their initial weight was 30.2 kg. The irrigated meadow consisted only of Italian Rye grass (*Lolium italicum*) resown every spring without being manured. It is about 1.5 km distant from the pig-sty, so the animals, which were turned out in the field for 2 ½ hours at a time for the first 6 weeks and for 3 hours at a time during the second period of the experiment, walked 6 km aday. The meadow is irrigated at intervals of 3 to 4 weeks with the drainage-water of the city. The pigs are let in as soon as the grass is 15 cm. high when it is still very digestible, rich in protein substances

and contains little crude fibre. When one plot has been grazed, it is mown down to destroy the weeds and obtain uniform growth; 3 weeks later, the pigs can be turned into the field again. During the growing season, each plot was grazed 4 times in turn.

The supplementary ration was fed in the sty and consisted of maize bran + fish-meal (10 : 1) + 1 % defecation lime, group 1 to 4 receiving respectively 0.25 — 0.5 — 0.75 — 1 kg. The results are given in the following table.

Pig Feeding Trials

Periods, or Groups	Increase in live-weight		Both sub groups	
	1st sub group (initial age 6 months)	2nd sub group (initial age 3 ½ months)	Average daily increase in live-weight	Consumption of concentrates to obtain 1 kg increase in live weight
	Kg	Kg	Kg	Kg
1st period				
1	1.6	1.6	0.035	7.2
2	2.8	5.9	0.119	4.2
3	6.5	9.6	0.173	4.0
4	8.1	11.3	0.243	4.1
Averages	4.8	7.1	0.145	4.9
2nd period				
1	5.7	6.4	1.16	1.7
2	8.0	8.1	1.90	2.6
3	8.0	10.6	2.35	3.3
4	10.0	13.5	2.93	3.4
Averages	7.9	9.6	2.16	2.8

Thus, an increase in the supplementary rations increased the live-weight of all the groups. Five hours are not long enough for the pigs to be at grass during the day, it is better for them to be turned out for 6, or 8 hours. The concentrates ought to be fed only in the evening, for the pigs eat a great deal of grass. Satisfactory results were obtained only from the 4th group in the second period, although all the animals developed well and were symmetrical. There is no doubt that grazing on clover lucerne and serradilla would have given better results.

III. EXPERIMENTS IN FATTENING PIGS ON DIFFERENT ALBUMINOID FEEDS. — These experiments were made at the Versuchswirtschaft für Schweinehaltung Fütterung und Zucht at Ruhlsdorf, they began on December 5, 1921, and lasted 8 weeks. The animals used were 21 Yorkshire ("Weisse Edelschweinrasse") aged about 4 months, and having an initial weight of about 35 kg. Three groups of 7 head each received per head and per day, barley bran 2 kg. throughout the whole of the test; turnips,

1 kg. during the 4 first weeks, 2 kg. during the other 4 weeks. The three albuminoid foods tested were: fishmeal, meatmeal, and yeast (125 gm. for the first 4 weeks, and 285 gm. for the other 4) they were fed to groups 1, 2 and 3. The protein content of the above substances was respectively 1.2 — 3.4 — 2.1 %. The daily increase in the live-weight per head in the first, the second period, and in the entire experiment was respectively: 1st group) 433 — 561 — 498 gm; 2nd group), 392 — 520 — 457 gm.; 3rd groups) 459 — 617 — 538 gm. Reckoning 8 kg. of turnips to equal 1 kg. of concentrates, the 3 groups in order to make 1 kg. increase in live weight consumed respectively 4.79 — 5.22 — 4.43 kg. of concentrates. Thus, yeast was the feed best utilised, and meat-meal ("Kadavermehl") the worst, further, the animals did not like it. Yeast is an excellent food for young pigs, but as it is poor in inorganic matter (7.5 %) it should be fed with a little lime.

IV. EXPERIMENTS IN PIG-FEEDING. — During the six years 1914-1919 two kinds of pig-feeding experiments were conducted at the Agricultural Experiment Station, Berkeley (California). In the one case, the animals were turned out to grass, in the other, they were kept always in the sty. The breeds used were Berkshire, Chester-White, Poland-China, Hampshire and Yorkshire. The questions studied and the results obtained were as follows:

1) *The value of supplementary foods for pigs on lucerne pasture.* — A lot of 22 pigs kept for 84 days, from August 25th, on a ration of rolled barley + grazing on lucerne increased 600 gm. per head and per day. They consumed 4.65 kg. of barley for every kg. increase in live-weight. A similar lot receiving in addition meatmeal and fine wheat sharps increased 635 gm. The greater expense of the supplementary ration was more than compensated for by the extra weight gained, but the addition of protein foods was really beneficial only when the lucerne became scanty.

2) *Production of pork with concentrates, or lucerne grazing* (barley is the chief concentrated food given to swine in California). — 96 pigs, four months old and with an average initial weight of 33 kg. were divided in 8 groups and kept for 84 days, dating from July 30, on the following rations: 1) only ground or rolled barley (the animals were kept in a yard without grass); 2) lucerne grazing + ground, or rolled barley; 3) lucerne grazing + barley fed by an automatic feeder (viz., consumed *ad lib.*); 4) grazing + rolled barley and meatmeal fed by automatic feeder; 5) ground, or rolled barley in the same amount as was given to lot 2 + lucerne fed twice daily in the rack; animals kept in yard without grass; 6) grazing on lucerne + concentrates in the same quantities as in the case of lot 2, but consisting of ground, or rolled, barley and half its weight of wheat bran; 7) same ration fed to lot 6, except the that concentrates consisted of 2 parts ground, or rolled barley + 1 part coconut cake; 8) same ration fed to lot 6, except that the concentrates were composed of ground, or rolled barley + 1 part spoiled beans, boiled, or a little salted. The pasture area was 20 ares (2000 sq. metres) per lot. Results: the average daily increase in live-weight per head for 8 lots was 320 — 360 — 580 — 630 — 325 — 335 — 360 — 340 gm.; concentrates consumed per 1 kg. increase in live-weight:

1) 5.6 kg.; 2) 3.76 kg. + grazing; 3) 3.93 kg. + grazing; 4) 3.84 kg. barley + 0.28 kg. meat-meal + grazing; 5) 3.86 kg. barley + 4.95 kg. green lucerne; 6) 2.52 kg. barley + 1.25 kg. bran + grazing; 7) 2.38 kg. barley + 1.12 kg. coconut cake + grazing; 8) 2.49 kg. barley + 1.21 kg. beans + grazing; average dressing yield for each of the 8 lots respectively: 68.2 — 74.2 — 80.5 — 82.9 — 67.1 — 76.2 — 72.7 — 63.8 %. The highest degree of fattening was obtained in lots 3 and 4. Beans produce flabby meat and a very low dressing-yield.

These tests were repeated, with some modifications, with lots 6, 7 and 8. The proportion of barley to bran was 2:1 in the case of lot 6, but was later increased to 3:1. As, however, diarrhoea affected lot 7 during the preceding test, the initial proportion of barley and coconut cake was 3:1 and gradually increased to 4:1. Lot 8 received maize and were given meat-meal in a separate trough. The results obtained were better on the whole than in the previous case. The daily increase in live-weight per head and per day being: 420 — 520 — 555 — 570 — 460 — 575 — 580 — 700 gm. The number of kg. consumed to make 1 kg. increase in live-weight were: 1) 5.99; 2) 5.20 barley + grazing; 3) 4.45 barley + grazing; 4) 4.42 barley + 0.14 meatmeal + grazing; 5) 5.60 barley + 1.60 green lucerne; 6) 3.50 barley — 1.50 bran + lucerne grazing; 7) 3.60 barley + 1.10 coconut cake + lucerne grazing; 8) 4.00 ground maize + 0.1 meat-meal + lucerne grazing; dressing-yields: 77.7 — 73.6 — 79.8 — 79.1 — 78.8 — 78.7 — 80.3 — 80.0 — 83.1 %.

Relative economy of a high, or low, grain ration combined with lucerne grazing. — Five lots each containing 10 pigs of the average initial weight of 27 kg. were kept for 135 days, dating from July 11, on the following rations + 20 ares lucerne grazing per lot; 1, 2 and 3 respectively 1, 2 and 3 kg. rolled barley daily per 100 kg. of live-weight; 4) barley *ad lib.*; 5) barley and coco-nut cake both fed in automatic feeder, viz. *ad lib.* The daily increases in live-weight were respectively: 155 — 260 — 375 — 520 — 550 gm. with a consumption of food, per 100 kg. live-weight increase, of: 230 — 317 — 382 — 480 — 463 (450 barley + 13 cake). After 135 days, only the 5th lot was ready for the butcher. It had attained the weight of 101 kg. All the other lots were, however, kept till they reached the same weight; this in the case of lot 4 required another 8 days' feeding on the same ration which was utilised to an equal extent. The first 3 lots were put in a yard without grass and given barley and coconut cake *ad lib.* Lot 3 had to be kept for 28 days more during which time the food consumed to make 100 kg. gain in live-weight was 404 kg. barley + 0.05 kg. coco-nut cake. The 2nd lot were kept 45 days and ate 409 kg. barley + 0.06 kg. coconut cake to make 100 kg. gain in live-weight.

The results of all these tests taken together show that pigs eating grain *ad lib.* consume more in the day than the ration fed animals when the amount is limited, but they utilise it better. The first required, for weights between 34 and 90 kg., 4.5 kg. barley for each kg. of increased live-weight while 4 kg. sufficed for the second. The use of automatic feeding-troughs saves labour and insures greater uniformity in growth, a better utilisation

of food, higher final weights and a higher dressing yield. To make 1 kg. increase in live-weight as much barley + meatmeal as barley alone is needed in order to obtain equal weight in the same time. Coconut cake should be given at the rate of 1 kg. for every 3 or 4 kg. of barley; in large quantities it acts as an aperient (1).

The rapidity of the live-weight gain varied much between individuals of the same lot, fed out of open troughs (from 60 to 100 % of the initial weight with the most favourable rations). It varied very little with the use of automatic feeders which prevent the stronger pigs from chasing away the weaker animals. With the increase in live-weight, there is a rise in the amount of food required to produce 1 kg. increase in live-weight.

The following experiments were made without grazing.

Value of different forms of lucerne for the production of pork and bacon. — Four lots of pigs with an average initial weight of 39 kg. were fed for 70 days, from January, 5, respectively on: 1) ground or rolled barley; 2) ground or rolled barley + whole lucerne hay fed in the rack; 3) ground or rolled barley + chopped lucerne hay ground up with the barley; 4) ground or rolled barley + lucerne hay meal ground with the barley. The whole, chopped, or ground, hay was fed in the same amounts. Average daily increase in live-weight per head: 415 — 420 — 400 — 450 gm.; food consumed per kg. of increased live-weight: 1) 5.14 kg. barley; 2) 4.65 kg. barley + lucerne hay; 3) 4.63 kg. barley + 0.67 kg. lucerne hay; 4) 4.10 kg. barley + 0.62 lucerne hay meal. The last was used to the best advantage.

Relative value of various forms of maize — Three lots, each of 10 head; average initial live-weight 40 kg., length of test 137 days, dating from January 12. Rations: 1) whole maize-ears + meatmeal; 2) maize grain + meat meal; 3) ground maize grain + meatmeal. Average daily increase in live weight: 400 — 370 — 360 gm.; consumption of food per 1 kg. increase in live-weight: 1) 6.20 kg. of maize (after deducting 16 % as the weight of the empty ears) + 0.28 kg. meat-meal, 2) 5.93 kg. maize + 0.31 meat-meal.

The consumption of grain per kg. of increased live-weight was always high. Maize is a little constipating and is better mixed with green lucerne, which is laxative.

Relative value of maize in various forms and of maize as compared with barley for fattening swine. — 1) whole ears of maize + meat-meal; daily average increase in live-weight 375 gm.; consumption per 1 kg. increase in live-weight: 6.02 kg. maize + 0.38 kg. meat-meal.

2) Ground maize meal + meat-meal: 405 gm. increase in live-weight daily; 4.98 kg. grain + 0.47 kg. meat-meal per kg. increase in live-weight.

(1) Similar results have been obtained from the experiments carried out in various parts of Ireland with palm oil cake by the Department of Agriculture. It has been found that this cake can well form one-third of the concentrates ration. Animals given it grew as well as those fed maize + bran in equal amounts; their flesh being as good, if not better. *Department of Agriculture and Technical Instruction for Ireland*, Vol. XXI, No. 3, pp 306-309, Dublin, 1921 (Ed)

3) Rolled barley + meat-meal: 610 gm. daily increase; 4.85 kg. barley + 0.21 kg. meat-meal per kg. of increased live-weight. The value of maize is 80 % that of equal weight of barley. Grinding effects a saving of 11 % as compared with soaking.

The relative value of skim-milk and of whey in fattening swine. — The average initial live-weight of the animals was about 28 kg.; average of two tests lasting 138 and 80 days respectively; supplementary foods respectively maize and barley 12.88 kg. whey equals about 7.94 kg. of skim-milk. To obtain 1 kg. increase in live-weight 62 % more whey than skim-milk is required. The least satisfactory results with whey were obtained in the case of the youngest animals which needed protein foods.

Comparative value of different supplementary protein foods. — Five lots, each of 10 pigs with an average initial weight of 55 kg. were kept for 70 days from October 10, on a ration of rolled oats put in an automatic feeder (consumed *ad lib*). This ration was supplemented in the case of lots 1 to 4 respectively with: 1) skim-milk; 2) milkolene" (trade name of a patented product), and condensed butter serum; 3) meat-meal *ad lib*.; 4) fish-meal *ad lib*. The fifth group served as a control lot. Average daily live weight gain in the first 4 lots (averages of two experiments): 710 — 560 — 650 — 610 gm. Foods consumed per 1 kg. increase in live-weight: 1) 4.55 kg. barley + 6.66 kg. skim-milk; 2) 5.77 kg. barley + 8.47 kg. "milkolene"; 3) 4.98 kg. barley + 0.19 kg. meat-meal; 4) 5.21 kg. barley + 0.25 kg. fish-meal. The 5th lot required 5.78 kg. barley. The results of this experiment show that the price of 1 kg. of skim-milk should be about $\frac{1}{17}$ of the price of 1 kg. meat-meal.

Spoilt raisins as a pig feed. — When added in order to partially replace the barley, in a ration of 5 parts barley + 1 part lucerne hay meal, these raisins have about the same value as the barley; if given in larger quantities, they produce diarrhoea, and considerably hinder the increase in live-weight.

Rations for weaned pigs. — Pig-breeding is continually increasing in importance in South Carolina. One of the difficulties that most generally besets the farmer is to know how to feed his newly weaned pigs. For this reason, the authors have made some comparative experiments at the Clemson College, Agricultural Experiment Station to ascertain the values of certain of the commonest well-balanced rations. In one experiment, animals of 31 kg. average initial live-weight were used; in the second, the average initial live-weight was 10 kg. The pigs were pure-bred Duroc Jersey and Poland Chinas. Rations: 1) Shelled maize + "red dog flour" (ground wheat embryos) + meat-meal (6 : 3 : 1); 2) shelled maize and twice ground bran with ground embryos + meat meal (6 : 3 : 1); 3) maize grain + wheat bran + meat-meal (6 : 3 : 1); 4) maize grain + wheat bran + ground oats + meat-meal (6 : 3 : 1). All the lots had at their disposal a mixture containing 25 parts by weight of charcoal + 3 parts of lime + 8 parts of salt.

In the average of the two experiments the mean daily increase in live-weight per head was respectively for the 4 lots: 375 — 340 — 280 — 259 gm.

The food consumed to produce 100 kg. increase in live weight was respectively for the pigs that had been weaned for some time (1st experiment) and for those just weaned (2nd experiment); 1st groups: maize 231.72 and 225.64 + ground embryos 115.86 and 112.82 + meat-meal 38.62 and 37.61; 2nd group: maize 258.72 and 235.38 + bran + ground embryos 129.35 and 117.69 + meat meal 43.12 and 39.25; 3rd group: maize 313.26 + 269.22 + bran 156.63 and 134.61 + meat-meal 52.21 and 44.57; 4th group: maize 301.26 and 249.54 + ground oats 150.63 and 124.77 + meat meal 50.21 and 41.59.

Thus, in decreasing order of merit, concentrated foods for piglings are placed as follows: ground wheat embryos — wheat bran embryos — ground oats — wheat bran.

F. D.

224. Silkworm-Breeding: Researches and Experiments in Italy.

I. — CASTELLI, L. I secondi allevamenti in Lombardia nel 1922. Esperimenti compiuti dal Comitato Regionale Lombardo "Pro Bachicoltura" *Bollettino della R. Stazione Sperimentale di Gelsicoltura e Bachicoltura*, Year 1, No. 5, pp. 183-195. Ascoli Piceno, 1922

II. — DELLA CORTE, M. and JELMONI, Risultati degli allevamenti con i bivoltini nelle altre regioni. — *Ibidem*, No. 6, pp. 217-224, 1922.

III. — JUCCI, C., Sulla curva di sviluppo del baco da seta — *Istituto Baccologico della R. Scuola superiore di Agricoltura in Portici (Estratto dal Bollettino del Laboratorio di zoologia generale e agraria)*, Vol. XXI, Portici, 1922.

IV — ACQUA, C. Le cure ai bachi di seta nella prima età sono di un'importanza capitale. *Bollettino della R. Stazione sperimentale di Gelsicoltura e Bachicoltura*, Year I, No. 6, pp. 224-231, 1922

V — MARTINI, L. (Direttore del R. Osservatorio Baccologico di Osimo), Intorno agli allevamenti dei bachi da seta all'aperto. — *Ibidem*, No. 6, pp. 208-216.

VI. — ACQUA, C. Ancora sull'utilizzazione delle sostanze grasse nei processi digestivi del filugello. *Ibidem*, No. 6, pp. 204-208

VII. — ACQUA, C. L'influenza del maschio nella trasmissione della pebrina del baco da seta. — *Ibidem*, No. 6, pp. 231-233.

VIII — Prove d'incrocio tra filugelli oro cinese e bivoltino giapponese *Ibidem*, No. 3, pp. 120-121, 1922.

IX. — LOMBARDI, L. Su di un incrocio stabilizzato a femmina bivoltina cinese e maschio oro. *Ibidem*, No. 5, pp. 180-182, 1922.

X — FOA, A. Il riconoscimento del sesso nelle crisalidi del baco di seta fatto con un semplice esame esteriore. *Ibidem*, No. 5, pp. 195-199.

XI. — DELLA CORTE, N. Influenza di una temperatura alquanto elevata nella conservazione del seme bachi durante l'autunno e i primi tempi dell'inverno *Ibidem*, No. 5, pp. 171-180.

I. II. — In 1922, the "Comitato regionale lombardo Pro Bachicoltura" (Lombardy Regional Committee for the Encouragement of Silkworm Breeding) made an extensive experiment with second hatchings, the young silkworms being distributed to the silkworm breeders and their rearing supervised.

The total amount of "seed" asked for was 810 oz., but the Committee only had at its disposal 150 oz (of 30 gm). In order to make the best use of this small supply, a room was arranged for incubation and for rearing the first brood, so as to be able to distribute, at all events within a certain radius, silkworms after their first moult, or at least, young silkworms, reserving the "seed" for persons known to possess the necessary knowledge to hatch it out. The eggs almost all belonged to the Japanese bivoltine breed, with a small percentage of hybrid eggs the results of crossing the bivoltine with golden Chinese. Double-yellow "seed" was discarded as having proved itself distinctly inferior to bivoltine in preceding years, although it had been produced and kept under the most natural conditions possible, the breeding-insects having been reared in the mountains and rather late in the season. The golden bivoltine cross was tried instead; this, when tested some years before on a small experimental scale, had given good results in so far that the cocoon was improved without detriment to the hardiness of the insect.

Silkworm breeders generally prefer to begin their second rearings at the beginning of July, but the yield then is lower as the critical time of the silkworms coincides with the period of the greatest heat.

Three series of rearings were made. 1) eggs (untreated) hatched out between July 5 and 10; 2) eggs (some untreated others treated with hydrochloric acid) hatched out from July 20-27; 3) eggs (treated with hydrochloric acid) hatched out from August 23-28.

Results: *Series 1* (July-August brood) average 15.4 kg. of cocoons per oz. of seed; 900 cocoons to the kg; duration of rearing period (from the time the caterpillars emerged, until they mounted the broom) 34 days.

Series 2 respectively. 24.7 kg (untreated seed) and 24 kg. (treated) per oz; 800 cocoons to the kg; 34 days. Treatment with hydrochloric acid does not therefore perceptibly decrease the vigour of the silk-worms.

Series 3: 21.1 kg. (excluding those affected with "calcino"); 860 cocoons to the kg.; 41 days, this last brood was too late; the best period to begin the second rearing, is at the beginning of August.

The yields would have been higher, if the average had not been reduced by crossing. They were much inferior to those obtained from the bivoltines, which were 11.5 kg per oz. in the first series, and 15 kg in the second; the cocoons were rather larger, 900 to 815 respectively going to the kg.

In the case of the most successful rearings, over 50 kg. were obtained per oz. of pure-bred seed and almost 50 kg. of cross-bred.

In estimating the returns, it must be borne in mind that as the second broods required one third less leaves, labour, and space, 30 kg. of cocoons obtained from them are equivalent to 45 kg. produced by the spring broods.

Repeated reeling tests made in previous years have shown that the bivoltine Japanese produces fine silk of good quality which reels well; the percentage of double cocoons is low.

The cocoons sell at prices varying from 21 to 30 lire per kg.

II. — DELLA CORTE, who was entrusted with the silkworm rearing

propaganda in Campania, gives the following data for results obtained from the second rearings in 1922. Seed distributed (Japanese bivoltine of the Nipponnshiki breed) at the end of January; silkworms hatched out between July 2 and 10, temperature rather high making the leaves wither soon and causing the death of several caterpillars especially during the earliest stage; no disease beyond a few rare cases of dwindling. Period of development about 30 days. Cocoons collected August 4 to 12. Average production 25 kg. per oz., maximum 52 kg.

JELMONI, "Direttore della Cattedra Ambulante di Agricoltura" (Director of the Travelling School of Agriculture) of the District of Treviso, gives an account of the results obtained in his district with Japanese bivoltines. The eggs hatched out in August; the silkworms mounted the broom for pupation 40-42 days later; cocoons were gathered 10-12 days after the caterpillars had finished mounting the broom. Average production 20-22 kg., quality of the cocoon and yield at the spinning-basins fair. The seed arrived 2-10 days late and therefore $\frac{1}{4}$ to $\frac{1}{5}$ did not hatch; otherwise the yield would have been higher.

The experiments made in 1922 and in preceding years have proved that the hybrid double-yellows with much prized cocoons and high yield also do very well in the province of Treviso, where the summer heat is never excessive.

In conclusion, the tests have been successful and deserve to be continued and extended. The bivoltine Japanese is perfectly adapted to breeding in Italy (1)

III and IV. — It has long been known that the silkworm shows most rapid growth during the earliest stages. Thus as far back as 1819, DANDOLO observed that the weight of 100 silkworms increased in the following manner: weight when just hatched about 1 gm. after the first, second, third, fourth and fifth moult respectively, 15 — 94 — 400 — 1628 — 9500 gm.

FÜCCI, by dividing the weight attained at every age by the initial weight has determined the "growth quotient" which has the following values for the native yellow (average of 2 rearings): 1st stage 14.134 — 2nd stage 6.037 — 3rd stage 5.745 — 4th stage 5.010 — 5th stage up to maximum growth 4.942.

The above results are in harmony with the data obtained in Japan by Hiratsuka EKKI who states that the average weight of organic matter accumulated by the silkworm during the first 24 hours of its life is 3.7 times its initial weight; later less material is collected, until in the 5th stage, it weighs hardly a quarter as much as the matter accumulated during the 1st stage.

The practical importance of these observations is to show that silkworms need most care during the first stage of their existence, and must on no account be allowed to suffer from scarcity of food. Breeders who give the very young caterpillars a fresh supply of leaves every 2 or 3 hours, even during the night, are usually very successful. Much labour and loss

(1) See R 1921, Nos. 188 and 327 (Ed)

is prevented by rearing the caterpillars on branches of mulberry which are placed in bottles of water and supported by a trestle (1).

V. — Authorities on silkworm breeding have long and repeatedly urged the expediency of rearing the insects in the open air, but the practice has never gained ground. The author refers to various attempts made by Italian silkworm rearers, and describes his own experiments conducted over 15 years ago at Osimo, where he reared silkworms on a small scale out of doors. The insects were kept in special cages with wire or linen sides and covered over at the top for protection against sun and rain, as well as animals. He was successful in thus rearing during the spring, summer, and autumn, various univoltine and bivoltine breeds; the insects were free from disease, produced fertile eggs and gave a high yield.

VI. — In a preceding paper (2), the author has called attention to the presence of an active lipase in the leaves of the mulberry and shown that the intestinal fluid contains a ferment capable of increasing the action of the lipase itself. Silkworms when given boiled mulberry leaves, at first eat them as readily as the raw leaves, then in constantly decreasing quantities; the insects grow more slowly and begin to die.

This fact can be explained by assuming that the heat has either rendered inactive the vitamin of the leaf, or destroyed the lipase. If the second view is correct, the excreta of silkworms fed on boiled leaves should contain much more fat than the excreta of silkworms given raw leaves. The author has found this to be the case, the amount of fat present in 8 gm of excrement being respectively 0.126 and 0.42 gm. He also discovered that silkworms fed raw mulberry leaves absorb the larger quantity of xanthophyll, while those given boiled leaves, absorb more chlorophyll. The questions now arise which he proposes to study viz, whether the leaf-pigments affect the colour of the cocoons, and whether feeding the larvae on raw or boiled leaves has any influence upon the last stage of the insect when it is engaged in silk production.

VII. — It has been ascertained that at least in the majority of cases, the males are incapable of transmitting pebrine during the act of fertilisation. It was for some time believed that such transmission was impossible because the oval corpuscles of pebrine are larger than the micropyle passages of the egg. This explanation, however, seemed doubtful after STREMPER had described stages of development in the life-history of *Nosema bombycis* in which the parasite was much smaller than the spores (ovoid corpuscles). Dr. FOA therefore, studied the dimensions of the micropyle passages as compared with the smallest forms of *Nosema bombycis*, with the result that she discovered the smallest form of *Nosema bombycis* to be the amoeboid binucleate spore of which the diameter considerably exceeds the diameter of the micropyle passages during the first part of their course.

VIII. — Some breeders were anxious to make experiments to determine whether the products of a cross between bivoltine Japanese and the

(1) See R 1918, No 327 (Ed)

(2) See R. 1918, No 196. (Ed)

Golden Chinese could be used for spring breeding. When the female is a Golden Chinese the F_1 generation is univoltine; if on the other hand the female is a Japanese bivoltine, it is necessary only to use broods that are accidentally annual, reserving the bivoltine insects for the second rearings. One of the chief objects of this cross was to obtain very hardly silkworms resistant to high temperatures. The tests carried out at the "Stazione Sperimentale di Gelsicoltura e Bachicoltura" of Ascoli Piceno with "seed" supplied by interested breeders have proved these aims to have been completely realised. The quantity of the product was also satisfactory. The same cannot however be said of the quality, the cocoons being rough and orange-yellow outside, and almost white inside. Yield at spinning-basins scarcely 11.9 %; very high percentage of double cocoons, 18 to 20 %; silk rough, without tenacity, pale with many white veins. It is therefore advisable not to experiment further with this cross, but to try mating the Japanese bivoltine with other golden types (1).

IX. — In 1917 ACQUA crossed the female Chinese bivoltine with the golden male hoping to secure, amongst other advantages, a race resistant to high temperatures. From this cross were obtained, by means of many broods in the summer and autumn, 23 generations. The race became fixed after the sixth generation. The cocoon is somewhat small and slightly strangled. Bivoltism shows a decided tendency to disappear, and it is therefore much easier to select an annual race that can be bred either in spring, or summer (hatching out of season).

X. — In the female silkworm, the segment corresponding to the 6th abdominal stigma, when seen from the ventral surface has its lower border sharply elongated so as to penetrate into the segment behind it; in the male, the border is straight. Other differences can be seen from the figures illustrating the article.

XI. — Since silkworm eggs are very susceptible to the conditions under which they are kept and especially to temperature, DELLA CORTE has tried to determine whether: 1) a high summer temperature is more favourable to them than moderate heat; 2) it would not be better to keep the eggs at a moderate heat during the autumn and the beginning of the winter, rather than to follow the general rule of leaving them exposed to the autumnal fall in temperature (2). As artificial hibernation is generally adopted, the effect of the natural winter temperature is of no importance.

ACQUA carried out experiments to decide the second question, and found that keeping up the temperature in the autumn and early winter had a decidedly favourable effect.

The author kept 100 oz. of native yellow "seed" laid on January 10, at the natural temperature (in a closed room), at Ascoli Piceno, and a similar amount in Cava dei Tirreni (Salerno), where the natural temperature

(1) Cf. REMO GRANDORI, Sugli incroci fra razze pure del filugello, *Annali della Stazione bacologica di Padova*, Vol. XLIII, Part 2, 1921; A. LÉCAILLON, Sur la variabilité de l'espèce et la création expérimentale, de nouvelles races chez le *Bombyx* du mûrier *Comptes rendus de l'Académie des Sciences*, Vol. 174, No. 26, pp. 1378-1740 Paris, June 26, 1922

(2) See also R. 1922, No. 299. (Ed.)

is much milder being from 3 to 11° C higher (generally about 5° C). Afterwards the two batches were placed in the same cold-storage chamber and kept there for some 90 days. The "seed" was then distributed to 96 silkworm rearers in 3 districts, two of which Foglienise (Prov. of Benevento) and San Donato Valcomino (Prov. of Caserta), are hilly, and one, Pontecorvo (Prov. di Caserta) is on the plain. The cocoon production in kg. per oz. of seed kept respectively at Cava and Ascoli was: on the hills, 73.68; 71.91, on the plain 67.68, 59.28.

These results seem to show that a rather high temperature in autumn, and during the first few days of winter, affords the best conditions for the systematic keeping of silkworm eggs and for obtaining vigorous insects.

F. D.

General.

225. The Immunisation against Red Water ("Tristeza") of Cattle sent to Brazil.

Misson, L. (Ancien Directeur de l'Industrie animale de l'État de São Paulo (Brazil)) L'Exportation au Brésil de la race Limousine *Revue de Zootechnie*, No 12, pp 253-258 figs 3, Paris, 1922

The author believes that the Limousin breed stands a good chance of being used in the improvement of the so-called national Brazilian breeds of cattle owing to the many points in which it resembles them.

All cattle imported into Brazil must be immunised against Red Water ("Tristeza"). The operation can be carried out before the animals are exported, or after their arrival in the country.

According to the author's calculations, a bull purchased for 4000 fr. and costing 3 800 for transport would cost the buyer 10 000 fr. if he had it immunised in France, but if the immunisation were carried out in Brazil the total cost of the animal would only amount to 8667 fr. including the necessary deductions for possible losses, or 8291 fr. if it were insured. Further, if the purchaser wishes the bull to be immunised in the country of origin, it is necessary to obtain an order 9 months in advance, whereas immunised cattle can be exported without delay.

F. S.

226. Contagious *Ecthyma* of the Lips in Sheep.

Mousson, G. *Ecthyma* contagieux des lèvres chez le mouton, ou "maladie du chancre". *Journal d'Agriculture pratique*, Year 87, Vol 1, No. 1, pp 12-15, figs 1. Paris, 1923.

The author describes the disease in its various forms and the type of animals it attacks and also discusses the pathogenetic causes and the most suitable name for the infection. The conclusions he has arrived at respecting the malady are as follows. Contagious ecthyma is due to seasonal conditions and a specific agent. It is spread by direct and by indirect contact, frequently by means of food and drinking-water. Diseased lambs can convey the infection to the teats of the sheep suckling them.

The best means of controlling the malady is the inoculation of all

uninfected animals, as immediate isolation of the first cases is usually of little use, and separating the sheep when the disease has once taken hold of the flock prevents it from spreading so quickly, but does not eradicate it. Inoculation is effected with virulent matter taken from a sheep in which the eruption has been well developed. This lymph is mixed with sterilised water, or water and glycerine, so as to obtain a homogeneous emulsion. The healthy sheep are inoculated by 2 or 3 punctures on the inside of the ear, or on the inner surface of the thigh, which treatment causes them no inconvenience, or general disturbance; they lose no flesh, and no complications ever arise.

A fortnight after inoculation, all traces of its effects have disappeared.

The author made some inoculation experiments of this kind last summer, with very satisfactory results. He is of opinion that inoculation should be carried out, even when all the sheep of a flock must be regarded as infected, and some of the cases have proved fatal. Inoculation ought to be effected as soon as the first well-characterised pustules make their appearance. When the eruption has once broken out on the animals' lips, the only thing to be done is to apply an antiseptic oil 2, or 3 times, which softens the crusts and causes them to fall without bleeding. The cure is much hastened by antiseptic dressings and the application of iodised glycerine.

F. S.

227. Means of Controlling Diarrhoea and Arthritis in Foals.

CONN, G. H. Diseases of Young Foals. *Live Stock Journal*, Vol. XCVII, No. 2545, p. 39. London, 1923.

Two diseases causing many deaths among young foals are diarrhoea and arthritis.

A foal suffering from diarrhoea begins by taking less milk from its dam, is low-spirited and has a slight fever. Then actual diarrhoea soon sets in; sometimes this gradually becomes worse and the animal evacuates with difficulty a watery liquid which is at first yellowish, and afterwards greyish, being frequently streaked with blood and emitting a disagreeable odour. If the diarrhoea persists, the foal becomes weak and loses flesh, in most cases however, the animal recovers.

The first thing to be done is to carefully regulate the ration of the dam and to give her every attention. If the indisposition is not serious at the beginning and is clearly due to the bad feeding or neglect of the dam, the foal must be given 3 or 4 times a day a spoonful of equal parts of phenylsulphite of zinc and soda dissolved in a little water, or else 10-15 drops of formalin 2 or 3 times a day dissolved in a pint of milk. This remedy is often called formaldehyde.

Foal arthritis is a contagious disease usually appearing during the first two days after birth and never later than the 4th week after birth.

It is generally characterised by a swelling of the joints, which are full of pus. Infection takes place by means of the umbilical cord which in these cases shrinks less rapidly than usual. The navel is slightly swollen and is hot to the touch. The foal does not run about much, or moves with

difficulty ; it has no wish to suck and has slight fever. In some cases, if the disease is treated at the outset the animal makes good progress, but at other times the symptoms become more serious and the disease is characterised by general blood-poisoning, when the veterinary must at once be called in. Frequently, however, this serious form can be prevented by taking great care of the mare, lodging her well, and properly treating the umbilical cord of the foal as soon as the latter is born. The umbilical cord should neither be knotted nor tied, but antiseptically treated and made to dry up as quickly as possible. This can be done by dressing it with formalin every 15 minutes for 3 to 4 hours ; after which the cord is dry and there is little danger of any infection.

The umbilical cord may also be treated with iodoformed collodion, 3 or 4 times in the course of the first day, or with tincture of iodine. The disinfection must be done thoroughly and with care. F. S.

228 **Training and its Effect on Animal Physiology and Morphology.**

DECHAMBRI., P. *Morphologie animale et Entraînement* *Revue de zootechnie*, No 11, pp 95-109, figs 10, table 1 Paris, 1922

The author after giving a definition and account of training, passes on to study the physiological and morphological changes taking place in the organism during the training process. One of the principal physiological results is the control of breathlessness. Contrary to what is generally believed, the panting animal does not lack oxygen, indeed, it takes in a great deal of this gas. The trained individual inhales less oxygen, but utilises it more fully. This leads to the freer elimination of carbon dioxide and other non-volatile acids. The latter, by increasing the acidity of the blood excite the respiratory system thereby inducing further activity in breathing. On the other hand, in the case of the trained individual, the susceptibility of the respiratory centre to the action of carbon dioxide and of other waste gaseous products would seem to be diminished.

Training, however, does not cure fatigue, but only prevents its becoming apparent so soon.

Racing has sometimes revealed a weakness of the circulatory system, especially of the lungs. Now a-days, muscular training is combined with breathing exercises intended to increase the exchange surface of the lungs and extend their movements. The question at once presents itself whether the trainer could not aim at obtaining a better, as well as an enlarged respiratory apparatus.

To attain this object, it would suffice to increase the resistance of the nerve centres to the action of carbon dioxide and neutralise the waste acid products by a larger alkaline reserve in the organism.

Training increases the activity of the circulatory system. The heart becomes larger, and the circulatory network more developed, while the red blood corpuscles are rendered more numerous. This higher haemoglobin content raises the respiratory capacity of the blood.

In order to show the effect of training on the morphology of the organism the author selected a swift animal. The muscle-fibres and the con-

tractile parts of the muscles were found to have been elongated. The skeleton is also affected, for the average height of the present race-horse is 10-13 cm. more than that of the XVIII century race-horse. Among the principal morphological consequences of training must be mentioned the great development of the thoracic cavity, and the elongation of the pelvis.

Owing to morphological adaptation (which also effects other professional functions) and to hereditary, as well as individual training, surprising results have been obtained. A race-horse can develop a speed of 16 m. per second, while the greyhound can run 18.15 m per second, and when coursing, even 27 m. per second. F. S.

229 **Weight-Height-Age Curve, an Index of the Nutrition and Growth of the Dairy-Cow.**

BRODY and RAGSDALE, A. (Department of Dairy Husbandry, University of Missouri, Columbia) A Weight-Height-Age Curve as a Measure of the State of Nutrition and of Growth of the Dairy Cow. *Journal of Dairy Science*, Vol. V, No 5, pp 479-484, diagrams 3. Baltimore, 1922.

The weight of a cow at a certain age is not in itself any index of its state of nutrition, for the animal may have inherited a rather heavier or lighter skeleton than the average and in consequence of the tendency to maintain a constant relation between weight and height, may weigh more or less than the average. The authors weighed all the 10 months-old Holsteins in the herd belonging to the Department of Dairy Husbandry of the University of Missouri, and found the difference between the heaviest and the lightest animal to be 122 kg; one cow taken by chance weighed 13 kg. less than the average. Therefore an experimental error can easily be made by comparing the weight of an average cow with one of the same age whose average individual variation is 13 kg., and may reach $122 \text{ kg.} : 2 = 61 \text{ kg.}$

Hence, in order to ascertain the state of nutrition of a cow under experimental conditions, it is necessary to introduce some form of measurement that takes into account the "hereditary dimensions" of the animal.

The investigations of WATERS, MUMFORD, TROUBRIDGE and their fellow-workers (*University of Missouri, Research Bulletin*) have shown that experimental conditions have little, if any, effect on height at withers. ECKLES (*University of Missouri, Research Bulletin* Nos. 31 and 36) states that during the period between birth and maturity, the increase in height at withers in the case of dairy cows is only 90 % whereas the increase in weight is about 1423 %. Hence, the withers height can be taken as an invariable measure of the hereditary dimensions of the animal at any age. Once the relation has been established between weight and height under normal conditions, it is easy to ascertain on this basis (the height being known) what the corresponding weight should be. On the basis of the data obtained by C. ECKLES, the authors have plotted a weight and height curve for Holstein and Jersey cows. After the height of the animal has

been ascertained the curve gives normal weight ; the difference between the latter and the actual weight will show the effect of the experimental conditions.

The curve plotted by the authors and reproduced in the appended figure, shows that there is a definite weight for a given height under ' normal ' conditions, independent of hereditary development, in fact, the curve of the relatively small Jersey cow coincides with that of the much larger Holstein ; this probably holds good for all milk breeds. It is very probable that the relation of symmetry is the same for all races of the same stock. The only difference between the various breeds of different hereditary dimensions consists in the difference between the relation age-height and

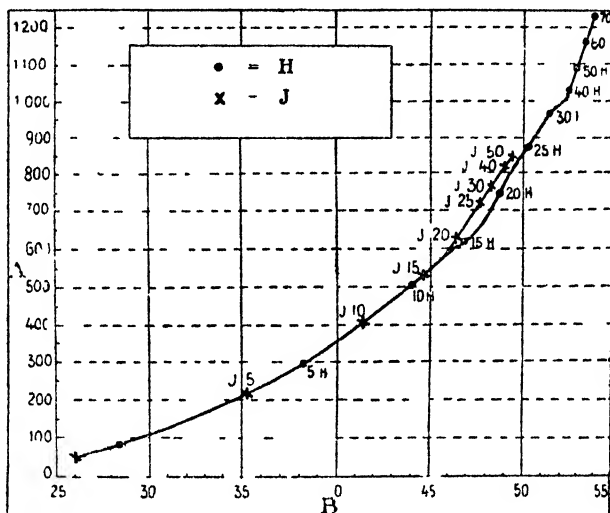


FIG 55 — Relation between the weight and height at the withers of Dairy Cows

A = Weight in lb of 454 gms

B = Height at withers in "thumbs" of 2.54 cms

H = Experimental values of the Holstein cow

J = Experimental values of the Jersey cow The age of the cows is shown by numbers representing the age, following the H (Holstein) or J (Jersey)

x = Jersey cow at birth

● = Holstein cow at birth

age. Thus, the weight-height relation of a 15 months-old Jersey cow is the same as that of a 10 months-old Holstein ; and the weight-height relation in a 50 months-old Jersey cow is the same as that of a 24 months-old Holstein cow. But for a given height, for instance, 115 cm., the weight is always the same (248 kg.) irrespective of breed.

Hence, this curve eliminates all errors due to individual variation, for the basal unit taken for plotting is the ideal hereditary dimension, and it serves not only as an index of the animals state of nutrition, but also of its growth as compared with the development of the average animal of the

same breed. Incidentally it can also be used for determining the weight, or height, of Jersey, or Holstein cows, of any age. F. D.

230 **A Study of the Metabolism and Respiratory Exchange in Poultry during Vitamine Starvation and Polyneuritis.**

ANDERSON, R. J. and KUIP, W. L., in *New York Agricultural Experiment Station, Geneva, N. Y. Technical Bulletin No. 88*, pp. 1-22, bibliography Geneva, N. Y., Feb. 1922.

Investigations undertaken to ascertain the changes that may occur in the metabolism and in respiration of poultry during vitamine starvation, *i. e.* the condition produced by feeding with polished rice before the appearance of polyneuritis. The results obtained confirm those already reported by ARDERHALDEN with pigeons.

In studying the respiratory exchange, a small apparatus was used, an exact duplicate of the one described by MURLIN (*American Journal of Diseases of Children*, Vol. 9, p. 43, 1913, *Cornell Univer. Medical Bulletin* 5 No. 2, 1915). The results obtained are shown in tabular form and the following summary is made:

The first apparent effect of a diet of polished rice is a loss of appetite, and food consumption decreases until finally it is completely refused. Loss in weight is gradual but continuous, and is accompanied by a similar decline in heat production.

The decrease in intensity of metabolism coincides with the decrease in food consumption but it depends upon several factors of mere voluntary consumption of food, because if the birds are fed forcibly, the utilisation of such food is much delayed.

The continued lack in the diet of vitamine B (water soluble), evidently causes a serious injury to the digestive functions which, during polyneuritis, results in an almost complete cessation of the digestion and assimilation.

In vitamine starvation there is no noticeable change in the respiratory quotient. During the first 3 or 4 hours after feeding rice, quotients approaching or exceeding unity were observed until a short time before the development of polyneuritis. About 18 hours after feeding rice the quotients ranged from 0.73 to 0.82.

The most striking effect in vitamine starvation is the inability of the birds to utilise a normal quantity of food, and the consequent decided decline in heat production. In some cases the latter fell to 50 % or more below the normal basal metabolism.

The metabolism sinks to a very low point when polyneuritis has progressed so far that symptoms of paralysis appear. The respiratory quotient seldom rises above 0.75 during this stage of polyneuritis, although the crop contains much undigested rice, indicating an almost complete inability, at the time, to utilise this food. Undigested rice has been found in the crop and gizzard more than a week after the last feeding. The heat production falls to 50 % or more below the normal basal metabolism.

After the bird recovers from polyneuritis the metabolism and the heat

production rise rapidly but the appetite remains poor, and the gain in weight is very slow.

F. D.

231. Application of the Forage Equivalents Method to the Feeding of Young Cattle.

LEROY, A. M., L'alimentation du bétail par la méthode des équivalents fourragers. Emploi d'un procédé graphique pour le calcul du rationnement des bovidés en voie de croissance *Revue de zootechnie*, No 12, pp. 215-225, Tables 3, figs 2, bibliographie Paris, 1922.

The maintenance ration of an animal varies according to its weight, and can be calculated by the following formula, $T = k \sqrt[3]{P^3}$ in which P = the weight of the animal, and k a constant factor. By means of this formula it is easy to plot a graphic figure with the weights of the animals as abscissae and the forage units of the maintenance as ordinates.

This graph (fig. 1) gives the maintenance ration necessary for animals of different weight. The production ration is obtained by finding the difference between the total ration consumed and the maintenance ration. In order to know the number of nutritive units required to make 1 kg. increase in weight, the composition of the different constituents of daily growth has been determined. These investigations have shown that the tissues formed during the first few months of the young animals existence represent, taking equal weights, a smaller gain of energy than the tissues developed during the following months. In fact, the tissues of young animals contain much water, a fair amount of nitrogenous substances, and are poor in fat, whereas the tissues of older individuals contain less water and more fatty substances. The relation (according to age) between forage units and growth is represented by graph II. This table shows that the gain in energy, as represented by 1 kg. of added weight, increases proportionally to the age of the animal. By means of these two graphic tables, it is easy to calculate the ration expressed in forage units, to be fed an animal whose age, weight and daily growth is known. In order to render the calculation of rations easier, the author has combined the two graphic tables into one.

Generally, the calf grows steadily, at all events until it is a year old. Taking this fact as a basis, the age of the animal can be determined as a function of its weight, provided the weight of the calf at birth is known.

The formula is as follows: $t = \frac{P - p}{g}$ where t = age; P = present weight of animal; p = weight at birth, g = the daily gain. Age is therefore a function of weight.

By reducing the graphic curve I to two straight lines, two linear equations can be obtained giving the maintenance ration as a function of the weight. The line of graph. II can also be expressed by a linear equation giving the growth ration required for 1 kg. increase as a function of the age. Since age is a function of weight, the value of the growth ration can also be calculated as a function of weight. From these two relations, it is pos-

sible to deduce a single formula which, if the weight of the animal and its average daily gain are known, will give the value in forage units and the required ration

Graph III gives the value of the total ration needed by animals of different weights, and for increases daily in weight of 0.5 kg. — 0.6 kg. — 0.7 kg. — 0.9 kg. and 1 kg.

The author mentions 6 instances in which the results of practical experiments carried out in different countries corresponded with the calculations made according to this last graph. He draws attention however, to the fact that the graph only gives the minimum rations.

As regards the composition of the ration, it may be remarked that an animal weighing 150 kg. ought to be given 30 % of the forage units in the form of hay, or green fodder, and 70 % in the shape of roots, tubers and concentrates. For an animal weighing 300 kg., the proportions are respectively 40 % and 60 %, and for one of 450 kg. 50 %. Care must also be taken that the ration contains at least 2 gm. of protein for every kg. of the animal's weight

The equivalents used in this study are as follows:— 1 forage unit is represented by 2.5 kg. of first cutting of meadow hay, 2.2 kg. aftermath, 8 kg. of green forage, 4 kg. potatoes, 5 kg. cotton-seed husks, 1 kg. of grain (barley, oats etc), 1.2 kg. maize flour mixed with the rachis, 0.8 kg. manioc flour and various cakes, and 10 kg. skim-milk. F. S.

232. Composition and Nutritive Value of Green Forage Silage.

HANSSON, NILS *Gronfoderensilagens sammansattning fodervärde och an vändbarhet Kungl Landtbruks Akademiens Handlingar och Lidskrift*, No 5, pp 413-434 Stockholm, 1922

The experiments with forage crops described in this publication in addition to the results noted in the *Comptes rendus de l'Institut Central de recherches agricoles* (No. 221) have led to the following conclusions:

1) Leguminous forage crops and hay if silaged carefully, form a valuable feed for milch cows.

The most satisfactory results have been obtained with fresh green silage consisting of 30 to 50 % leguminous plants, cut when well matured, i. e. when the pods are fully developed.

The forage should be well chopped up and stacked in such a way as to allow free circulation of air. The damping of forage which contains a large amount of dry matter, owing to undue desiccation, and the watering of the upper layers in the silo, helps to exclude the air and encourages good fermentation.

3) The composition of the silage remains unchanged before and after ensilage. However, owing to moisture evaporation, the content of dry matter increases and certain modifications take place in the composition of the nitrogenous and fatty content (ether extracts).

A large proportion of the albuminoids are transformed into peptones and amino acids, and owing to their solubility, finally become changed into amides, retaining however, their former value as albuminoids. Even in

cases where fermentation took place under the best conditions, about 10 to 20 % of the total nitrogen content of the forage was transformed into ammonia and was consequently lost.

During fermentation in the silo, the sugar and the carbohydrates gave rise to considerable quantities of organic acids, partly fatty acids, lacking however the nutritive value of fats. Certain samples of silaged feed considered as quite satisfactory, possessed on analysis up to 1% free acids. On the other hand the presence of butyric acid indicates a badly made silage.

4) Green silage has a favourable influence on milk production ; the effect on the fatty content of milk may be compared with that of neutral forages

5) When the silage is well made, 6.5 kg. of silage consisting of 30 to 50 % leguminosae, or 7 to 7.5 kg. of hay, corresponds to 1 food unit.

These two feeds contain 1.75 to 1.80 gm. of dry matter. These figures should be *higher* in the case of oats and barley silage, or if the silage has not been made successfully.

6) For milch cows, the fresh silage forms an excellent winter feed and may be used to substitute fresh fodder, at the rate of 15, 20 or 25 kg. or more per cow per day. Thanks to the high content of dry matter this may also serve to a certain extent to replace straw. The rich albuminoid content will permit also the making of meal cakes. Green silage, well turned, contains 3 to 5 times more albumin than the roots of forage crops.

7) Green silage has a dietetic value and has a slight laxative effect.

8) Certain inconveniences are however associated with cheese making, more especially in cases where full ripening is necessary. The cheeses made with milk from cows fed on silage often ferment to excess and exude a large amount of gas.

(Corr Sweden)

Breeding

233 Heredity and Chromosomes in the Horse.

ROBERTSON, J. B. Chromosomes and Purity of Breed. The Determination of Sex. *The Bloodstock Breeder's Review*, Vol. XI, pp 104-112. London, 1922.

The number of chromosomes in the horse can be best studied from recently removed spermatocytes and ovaries. In England, it has been decided that the diploid number is 26 and the haploid number 13, but WOODSEDALE gives the numbers as 36 and 28 respectively.

This difference however, has no effect upon the number of generations needed to eliminate impure blood by the constant use of a pure-bred sire. In order to determine how many generations were required for this purpose, the author's son made the following simple experiment about 2000 times : 13 red balls representing the chromosomes of a pure-bred sire and 13 black balls representing those of a dam of mixed blood were put together in a bag. Then 13 balls were taken from these at random and introduced into another bag containing 13 other red balls ; this was repeated until

all the 13 balls taken at random were red. If we suppose that each bag containing 26 balls represents one generation, the averages obtained from these experiments were as follows :

Generation	Impure chromosomes	Pure chromosomes	Total No. of chromosomes
1	13	13	26
2.	7	19	26
3.	3	23	26
4.	2	24	26
5.	1	25	26

The same experiment was made with 18 red balls and 18 black balls. The results obtained were as follows :

Generation	Impure chromosomes	Pure chromosomes	Total No. of chromosomes
1	18	18	36
2.	9	27	36
3.	5	31	36
4.	2	34	36
5.	1	35	36

These theoretical results do not agree with what actually occurs. If a Shire mare (mixed blood) is mated with a pure-bred stallion, and each mare resulting from this cross is served by a pure-bred horse, an animal with the conformation and characteristics of a thorough-bred is not obtained in the 6th generation.

On the other hand, it has been found that certain characters are retained almost unchanged to the 22nd generation at least, in spite, of the constant introduction of chromosomes containing other characters.

The horse, Legality, a descendant in the 22nd generation of ALCOCKS Arabian is grey like his ancestor, the 21 mares forming the chain between the two individuals were, with one exception, served by whole-coloured stallions, themselves the offspring of whole-coloured ancestors.

These facts may be explained by crossing-over which would account for the presence in the germ-plasm of certain characters that ought to have been eliminated long ago according to the theoretical calculations set out above, but which are based on the integrity of the chromosomes.

According to MORGAN, the characters of which the factors exist in the same chromosome have a tendency to reappear together. This theory would account for the occurrence in the horse, St. Simon, for instance, of the brown coat, peculiar conformation (dished face, wide interdental space, 5 lumbar vertebrae, straight tibia and hocks) extraordinary character of nervous system and durable qualities of muscle that characterised Galopin, whereas in Robert the Devil and Barcaldine, the factors of their qualities must have been scattered among different chromosomes and hence had little chance of re-uniting in one individual.

From observations hitherto made it would appear that in the case of the horse, the male gametes producing males, circulate more rapidly in the reproductive organs of the female than the male gametes giving origin to female individuals. The author is therefore of opinion that the only way of influencing the ratio of male to female birth would be to change the rate of the progress of the two kinds of gametes on their way to fertilise the ovum.

Although agreement has not yet been reached as to the number of chromosomes present in the germ-cells of a horse, it is generally admitted that 50 % of the male gametes have a certain chromosome which may be called X, while the others are without it. No male gamete seems to have the chromosome Y. According to WODSEDALEK, the ripe ova have 18 autosomes and one chromosome X. Therefore the number of male and of female births ought to be equal, but in point of fact, the former are slightly more numerous owing to the reason given above. From 1871 to 1920, out of the 136 811 pure-bred foals registered in England, 68 684 were colts and 68 127 fillies, the difference being thus 0.4 %. In the horse, the chromosome X very probably contains the inhibitory factor of the sexual character and of the male secondary sexual characters. There would appear to be a strict connection between the strength of these secondary factors and the racing aptitude of fillies and mares, and especially between these factors and the vitality of mares. The most powerful hormones secreted by the ovaries of a mare probably injure the animals' racing powers. F. S.

231 Sex Ratio and Unisexual Sterility in Hybrid Animals.

HALDANE, J. B. S. *Journal of Genetics*, Vol. 12, No. 2 pp. 11-109, bibliography. Cambridge, 1922.

Many observers have noted that the crossing of various animal species (insects, birds, mammals, etc.) produces an offspring, one sex of which is rare or absent, or if present is sterile, whilst occasionally the missing sex is represented by intermediate forms. DONCASTER concluded that the missing sex was generally the female.

The author gives a summary of various results obtained by different investigators, and concludes that the above rule does not apply in every case, but that with one certain and a few doubtful exceptions, "when in the F_1 offspring of two different animal races, one sex is absent, rare, or sterile, that sex is the heterozygous sex." F. D.

235 First Generation Hybrids for Egg Production.

ELLERMAN, W. T. S. The Crossbred for Egg-Farming. Why the Purebred is losing Favour. *The National Poultry Journal*, Vol. III, No. 138, p. 464. London, 1923.

The author states that all the White Leghorn fowls now reared in England belong to a few families imported from America and Australia, or else have been bred in the country for show purposes.

The breed only became popular about twenty years ago, and the flocks have never been improved by the introduction of fresh blood. Since 1903, the race has been continued by pure-bred birds alone which has resulted

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in a great degree of consanguinity. Inbreeding is necessary to fix certain characters, but after a time it produces diminished vitality to which cause the author attributes the high percentage of mortality found among broods of white Leghorn, White Wyandotte and Rhode Island Red chicks.

Recourse must be had to crossing in order to improve egg-production, therefore every poultry-rearer should keep some birds for experiments and as a means of infusing fresh blood into pure breeds.

It is maintained that a first cross between two pure breeds will lay as many eggs as its mother and female relatives on the paternal side, and be endowed with more vitality than its parents.

The fact that a high egg yield is a genetic factor does not appear to have been sufficiently taken into account. If the parents come from good laying stock their progeny will inherit this character irrespective of any crossing.

The author is of opinion that before long the whole stock of egg-farms will consist of the first generation hybrids of breeds celebrated for prolific egg-production.

F. S.

236 "Crossing-Over" in Fowls.

SERESBROVSKY, A. S. Crossing-Over Involving Three Sex-Linked Genes in Chickens *The American Naturalist*, Vol. I, VI, No. 647, pp. 571-573. New York, 1922.

Plymouth Rock fowls possess three hereditary factors. "suke" (which hinders the growth of the feathers and wing-development), "tuge", (which produces the white colouring), and "trage" (which gives the barring to the plumage). These factors are absent in the Russian Orloff breed. On crossing an Orloff cock with a Plymouth Rock hen, males are obtained which possess these three factors; the females, however, are without them. These hybrids of the first generation when mated, produce offspring mostly of the "asuke", "tuge", "trage", or "suke", "atuge", "atrage" type, although there are a few individuals of the "suke" "tuge", "atrage" form. Thus, more crossing-over takes place between the factors "suke" and "tuge" than between "tuge" and "trage".

The data obtained from these experiments do not admit of any definite determination of the order of the genes, or of the distance between them.

F. S.

Special.

237. The Rearing of Draught Horses and Cattle in Alsace and Lorraine.

HITIER, H. La sélection des races animales en Alsace et en Lorraine. *Journal d'Agriculture Pratique*, Year 86, Vol. II, No. 43, pp. 354-356 Paris, 1922

According to the report of M. STRÈNE, Director of the Strasburg Stud-Station, there were 37 stallions in the Station in 1870. Of these animals, 30 were Anglo-Normand and 4 pure-bred English horses.

The rearing of thorough-breds met with little success as draught-horses were chiefly required. In 1889, there were still only 4 draught horses among the 64 stallions kept at the Stud Station, but since that date, draught horse stallions alone have been used in Lorraine. In 1914, 60 out of the 77 stallions at the Strasburg Stud Station were draught animals, and in 1922, the latter represented 40 of the total stock of 65 stallions.

These draught-horse stallions belong to the Ardenne breed which has formed the basis of all the improvement made in the horses of Alsace Lorraine and also of the Upper and Lower Rhine. Private stud-stations are very prosperous in Lorraine. Horse-breeding is also much supported by the syndicates forming the Association of the Syndicates for breeding the Ardenne-Lorraine and Lorraine horse.

The use of the stations is regulated by a local law which required that the animals shall not only be free from redhibitory defects but also possessed of certain good qualities.

Simmenthal and Dutch cattle are bred in Lorraine. The Dutch breed is very common in Moselle, and in the neighbourhood of the large manufacturing centres.

Formerly, there were several breeds of cattle in Lorraine a red-pied breed, and the Fribourg and Simmenthal breeds. Now, an attempt is being made to improve the stock and render it more homogeneous. To this end, breeding animals have been imported from Switzerland and the Duchy of Baden. The service of communal bulls has been also instituted. In each Commune, one bull duly approved by a Special Commission has to be kept for 50 cows, or heifers, and periodically examined by a veterinary. The purchase and maintenance of this bull devolves upon the Commune. Excellent results have been obtained from this system. At the present time, the bulls of the Alsatian plain belong to the Simmenthal breed. More than 300 of them have been imported since the Armistice.

Dr. THISSE is of opinion that the improvement of cattle-breeding will be carried out on the following lines. A limited number of purebred stud bulls will be introduced and entrusted to the Breed Syndicates and Communes where stock-breeding is most advanced. The other Communes will have to buy their bulls from the Breed Syndicates which will form breeding centres.

F. S.

Horse-Breeding in Czecho-Slovakia.

JILEK, F. (Prof at the Polytechnic Institute of Prague), and KUKLOVA, M. *Élevage du cheval in Tchécoslovaquie Revue de Zootechnie*, pp. 202-210. Paris, 1922.

Abstract. — The authors, after describing the breeding of army horses, pass on to study the draught-horse.

Since 1880, many Belgian horses have been imported, some of them were of the Ardenne type, and others of the Brabançon type. There is at present a tendency to prefer the Ardennes horse to the Brabançon, as being more adapted to the work of the country. Since, however, the Ardennes animals increase in size after the first generation, it has been found

necessary in order to maintain their heavy build, and good qualities to import stallions and brood mares annually from Belgium and Holland.

High spirited stallions must only be introduced where there are high-spirited mares, for hybrids between the two types are useless for breeding since the intermediate characters are difficult to fix, and these half-bloods seldom inherit the good qualities of both parents.

The light draught horse will still be indispensable for a long time in the mountain districts. Unfortunately, the brood-mares and stallions of that type present little homogeneity. With a view to obtaining a high-spirited animal of heavier build and more suited to agricultural work, the authors recommend mating light mares with stallions from Oldenburg and East Friesland. As soon as more homogeneity in the brood mares has been secured and they are no longer so massive, it will be well to introduce Oriental, and Anglo-Norman half-bloods, or half-blood English animals.

Moravia — Here, the conditions of horse-breeding are nearly the same as those found in Bohemia. There are, however, more stallions of Oriental origin and more resources for the production of the high-spirited, heavy horse. For breeding heavy draught-horses, the Ardennes type of the Belgian horse is chiefly in demand.

Slovakia — Agriculture is not so advanced in this country as in Bohemia and Moravia, but the natural conditions are very favourable to horse-breeding, especially on the spurs of the Carpathians.

In South Slovakia, the strong cart-horse of half-blood English origin, or descended from the Anglo-Normans of the Nonius breed is chiefly reared. The horses of this breed are greatly prized and are models of what a high-spirited agricultural horse should be. They are perfect draught horses, hardy, and resistant and have very gentle dispositions.

In the centre of Slovakia, a light carriage, or saddle horse is chiefly bred from Lipitzan, Arab and Anglo-Arab sires. Where, however, the ground is flatter, a stronger type of Oriental horse is bred by preference.

In North Slovakia, and in Carpathian Russia, the Houtzoul type of high-spirited pony is reared. This animal is small, but strong and enduring, being well suited for hauling cannon in mountain districts.

In this article, the authors give the different Stud-Station for each area and the number of Service Stallions of each breed kept there. F. S.

239 Hackney Breeding in England.

LANCASTRIAN Where is the Future of the Hackney An Old Breeder gives a Timely Warning *The Live Stock Journal*, Vol. XCVII, No. 2595 pp 37-38 London, 1923.

Hackney breeding in England is at present passing through a crisis of which the following are some of the chief symptoms: the small number of animals of the Hackney breed exhibited at utility shows, the lack of uniformity and continuity in breeding methods, the small number of well-shaped stallions that are found in the country by the agents of foreign Governments, and the closing of the Hackney Stud-Book two years ago.

The author attributes this crisis chiefly to the great importance now attached to action and high-stepping, to the detriment of other more important qualities. Owing to the vagaries of fashion, the breeding of Hackneys has passed into the hands of the rich who regard it as a kind of hobby, and the public, accustomed to see at Hackney shows only horses of a fancy type and bred without any view to their utility, have come to regard the breed as consisting of animals having no practical or commercial value. The result is that in addition to the few horses of the type in vogue, there are many others which differ from this type and can therefore find no purchasers. Whatever type breeders may try to reproduce, there will always be a large number of horses that are below the standard, and the prosperity of a breed depends upon the market for these rejected animals. If the latter find a ready sale, it may be concluded that the type in vogue is a good one, for all the successful competitors at Shows will generally be those possessing the fashionable qualities to an exaggerated extent, whereas in the great mass of the horses, these qualities will be considerably modified, so as to have a practical and commercial value.

If on the other hand, these animals are not in any demand, it may be taken for granted that the fashionable type is worthless.

The author believes that the only remedy for this crisis is for the breeding of the Hackney to be once more in the hands of those who practised it with such success in the past and gained for the breed the good reputation it used to possess. Therefore broad, strongly-built horses should once more be reared with short legs, good feet, flat bones, intelligent heads, flat back, solid loins, and perfect shoulders. The animals must be suited for both riding and driving, have a deep chest and as good paces as possible.

He also expresses the hope that the Council of the Hackney Horse Society will use their influence with the judges at ~~the~~^{these} shows so that a good general conformation is not sacrificed to brilliancy.

There is still time to... Many merchants and large
as have given up... returned to the use of horses.
the rise of the farmer-... and the creation of many small holdings
result... the subdivision of large estates, the demand for horses will
rise... Hackney breed will, however, only be able profit by this op-
if the horses that do not satisfy the demands of fashion have a
practical and economic value F. S.

F. S.

Suffolk-Punch for Town Work.

E. C The Suffolk-Punch as a Town Horse *Live Stock Journal*,
No. 2545, p 39. London, 1923

still-existing prejudice against the Suffolk horse is that it is
 pork in towns. Horse-dealers declare that this animal has
 bones.

to a gentleman, A. YOUNG's description of the breed which was given at a time when the Norfolk horse was much less well-formed than at the present day. He had a bony frame and very short pasterns.

Without claiming that the Suffolk Punch is perfect in this respect, it should in justice be said that this horse is as good as any other for drawing carts. The present Suffolk horse has well-proportioned joints of sufficient length and its pace is very good for a roadster.

When the cannon-bone measurements of horses with round bones and those of the Suffolk are compared it is found that the circumference of the common-bone of the Suffolk is smaller, but it must not be forgotten that the Suffolk has a thinner skin and less hair. One great advantage characterising this horse is the excellent quality of its bones which preserve their elasticity to an advanced age. The author believes that Suffolk Punches will soon be in great request for work in towns where the use of horses that are easily frightened and unmanageable may entail serious danger and even loss, as the breed is celebrated for its extreme docility, a quality possessed even by the stallions. Further the Suffolk pulls well against the collar, and the fact that its legs are not feathered is a great advantage in bad weather as less grooming is required than in the case of horses of the two other heavy English breeds, the Shire and the Clydesdale.

F. S.

241. The Bordelais Breed of Cattle.

GOUIN, R. La race bovine bordelaise *Revue de Zootechnie*, No. 1, pp 1-12, figs. 4 Paris, 1923

For many centuries the boats laden with wine leaving the port of Bordeaux for the Netherlands have returned with a cargo of Dutch cows. The stock of these cattle has been kept up in the Bordeaux district by means of continual purchases. The French boats also touched at the Brittany ports and shipped thence small cattle for the poor districts of the Landes.

The author considers that the Bordelais stock has been formed from these two types of cattle, probably by their crossing. According to MAXWELL, however, it is an Irish breed. His theory finds a certain amount of support in the fact that the name formerly given to it was "Queen", or rather "Gouine", a corruption of the word GWYN, the patronymic of an Irish family formerly owning large estates in Ireland. In any case, whether or not the Bordelais cattle are of Irish origin, there is no doubt that their constitution has subsequently been influenced permanently by the admixture of Dutch and Breton blood.

The author afterwards describes the geographical area occupied by the Bordelais breed and the uses to which the animals are applied. According to the Herd-book, Bordelais cattle must answer to the following description.

General conformation: body angular, especially in the female; neck slender, withers projecting, shoulder flat, pelvis wide, flanks projecting.

Head long (dolichocephalic type), bony, forehead slightly dish; eyes prominent, occipital protuberance well-marked.

Coat body pied-black, spotted. Head, muzzle and eyelids completely black. Tip of tail and extremities of limbs black. Periphery of anus and vulva black; teats black, sometimes marbled; horns frontal,

dark at base, blackish at the tips, rising laterally, often incurved forwards, hoofs dark.

Height ranges between 1.20 m. and 1.35 m.

Expression gentle and intelligent.

Gait graceful and quick.

Temperament nervous-sanguine.

At calving, the Bordelais cow frequently gives 18 to 20, and even 22 litres, of milk, its total annual milk yield may vary from 2500 to 3000 litres. The milk contains according to a test made by M. VIDEAU, 35.83 gm. of butter-fat. The Bordelais cow is remarkable for the length of its lactation period

The author concludes by mentioning the Associations formed recently for the improvement of methods of breeding of the Bordelais cattle and shows how this work, which was interrupted by the war, can best be resumed.

F. S.

242. Finishing Fat Cattle.

TINLIE, M. J. (Superintendent, Experimental Station, Scott, Sask.)
Finishing Steers for Market in North-West Saskatchewan. *Dominion of Canada, Department of Agriculture, Pamphlet No 17, New Series*, pp. 10, figs. 5. Ottawa, 1922.

The author gives the reasons for fattening cattle in Saskatchewan, the results obtained from the experiments conducted by the Dominion Experimental Station at Scott (Sask.) for the purpose of ascertaining the advantages gained by beginning fattening during the winter, and the differences between the price of cattle in summer and autumn from 1917 to 1922.

In order to fatten steers in winter, no expensive sheds are required, it is necessary only to protect the animals from wind and snow.

The ration fed at the Experimental Station of finishing steers, consisted chiefly of crushed oats and rye, equally good results were, however, obtained with well-ground screenings mixed with chopped oat-straw. The chief roughage fed was straw. In 1919, experiments were begun to ascertain the value of sunflower silage for fattening oxen. One lot of animals was fed straw and grains, while the other received the same ration plus sunflower silage. The experiment lasted two years. The results proved that silage keeps steers in good condition owing to its succulence, and that animals fed on sunflower silage have a more uniform finish than those given straw and grains. The latter ration is, however, quite satisfactory, so that silage is not indispensable.

During the winter 1921-1922, an experiment was made to decide whether there was any advantage in fattening steers earlier than the usual age.

Two lots of 6 steers were used in the experiment; in one lot the animals were 18 months old and in the other 30 months. One lot was fed grains and the other grains plus ensilage. The 18 months old steers cost 3 cents per lb. of live-weight, their average increase in live-weight was 238 lb. per head and they fetched 4 cents per lb. The 30 months-old steers cost 4 cents per lb., they increased 212 lb. on an average per head and were sold at 6.36 cents per lb.

Another experiment was made to compare the fattening properties of hornless steers, and of steers than had been dehorned. Both lots were fed the same ration during the course of the experiment which lasted several months. At the end of the first month of fattening, the hornless cattle had the advantage over the others, the difference in weight being 11.5 kg. They maintained their superiority to the end of the experiment when they weighed 20 kg more than the dehorned cattle. The author, however, sets against this loss the unquestionable fact that the dehorned animals were rendered less dangerous, and sold at higher prices.

F. S.

243. The Scientific Feeding of Dairy Cows.

MALPEAUX, L. (Membre correspondant de l'Académie d'Agriculture) *Alimentation rationnelle des vaches laitières. Le lait*, Year 2, No 9, pp. 778-786. Lyons, 1922.

The author having explained the theory of food substitution proceeds to show how it may be applied in the case of dairy cows. A deficiency of nitrogenous matter in the ration causes the breaking down of the nitrogenous substance of the body in order that the udder may continue to function. Farm produce, however, liberally fed, is too poor in nitrogenous matter to sustain a normal lactation. A ration including 10 kg. clover hay, 40 kg mangels, 25 kg oat straw and 2 kg finely chopped straw contains 1.223 kg. nitrogenous matter and a nutritive value of 7.225 kg. and costs at the present time 7.25 fr in France. Such a ration will produce 10 to 12 litres of milk. With the addition of 2 kg of bran the weight of the nitrogenous matters rises to 1.449 kg and that of the nutritive value to 8.085 kg. and the cost price of the ration in 8.52 fr. On comparing these figures with those of the following ration, it is easily seen that the use of oil-cakes reduces feeding costs. Composition of ration: clover hay 5 kg., mangels 25 kg, oat straw 5 kg, chopped straw 2 kg.; peanut cake 2.5 kg. This ration contains 1.833 kg. nitrogenous substances and has a nutritive value of 6.7 kg.; its cost is 6.35 fr.

On account of its milk-producing qualities 1 kg. of bran may be added to the latter ration when its food value rises to 6.130 kg, whereas the amount of nitrogenous substances is 1.946 kg. This ration costs 6.85 fr.

It is necessary to incorporate in the ration food-stuffs with a high percentage of nitrogen, such as oil cakes, especially groundnuts, cotton-seed, linseed, cocoanut or sesame. If straw is added to a certain weight of oil-cake, it compensates for a reduction in the hay and roots. When fodders, or mangels, are scarce they may be replaced by cake, the proportion of straw being increased to keep up the volume of the ration.

The author also gives some formulae for rations that can serve as a general guide.

F. S.

244. A Case of Twinning in Dairy Cattle.

HAYDEN, C. C. *Journal of Heredity*, Vol XIII, No 1, pp. 22-24, figs 4. Washington, 1922.

At the Ohio Agricultural Experiment Station, a purebred Holstein-Friesian cow has produced twins five times out of seven, and it appears

that she comes from a prolific family, also given to bearing twins. This breed is noted as a good producer of milk and butter fat.

It has been suggested that a breed could be obtained which would produce a high percentage of twins, but the high proportion of males to females in the sets, and the sterile nature of the latter makes the result of doubtful value.

F. D.

245. The Effect of the Age of Cows and the Duration of the Lactation Period upon Milk Yield.

WILSON J. *The Scientific Proceeding of the Royal Dublin Society*, Vol. XVII, N S, Nos 11-13, pp 97-104, tables 3, figs 2, Dublin, 1922.

The author first criticises: 1) the data furnished regarding the cows that competed at the London Dairy Show during the 12 years previous to 1909; 2) the data supplied by GARVIN who based his returns on the yield of dairy cows belonging to Lord Rayleigh in Essex (England), 3) MINER and TOCHER's data elaborated by Dr. R PEARL, and obtained from the statistics published by the Scottish Milk Records Committee on the subject of the yield of Ayrshire cows from 1903 to 1912

After explaining why the information given by the latter investigators does not help in determining the average effect of the age of a cow upon its milk yield, the author draws the following conclusions from the two first-named sources:

1) Taking the yield of a cow of 8 years of age as 100, at the ages of 4 — 5 — 6 — 7 — 8 — 9 — 10 — 11 — 12 — 13 — 14 — 15 — 16 — 17 — 18 — 19 — 20 — 21 — 22 — 23 — 24 — 25 — 26 — 27 — 28 — 29 — 30 — 31 — 32 — 33 — 34 — 35 — 36 — 37 — 38 — 39 — 40 — 41 — 42 — 43 — 44 — 45 — 46 — 47 — 48 — 49 — 50 — 51 — 52 — 53 — 54 — 55 — 56 — 57 — 58 — 59 — 60 — 61 — 62 — 63 — 64 — 65 — 66 — 67 — 68 — 69 — 70 — 71 — 72 — 73 — 74 — 75 — 76 — 77 — 78 — 79 — 80 — 81 — 82 — 83 — 84 — 85 — 86 — 87 — 88 — 89 — 90 — 91 — 92 — 93 — 94 — 95 — 96 — 97 — 98 — 99 — 100, it will be respectively 67 — 80 — 90 — 95 and 98.

2) No sufficient data are available to ascertain the milk yield of two-year-old cows. According to the two above-mentioned sources, the milk yield of cows at the age of 2 ½ years would appear to be 50. No figures can yet be given as to the milk yield of cows that are less than 5 years old.

Generally, the amount of milk produced by a cow during the lactation period is recorded, but since lactation periods are not always of the same length, it is necessary in instituting comparisons, to know the amounts that must be added, or subtracted, from the total yield of one lactation period in order for it to have the value of an ordinary lactation. A normal lactation is the yield estimated for a lactation period of 12 months. According to the data furnished for Ayrshire cows, for the year 1920, an 11 months, lactation period includes on an average 38 weeks of milk production, while in lactation periods of 12, 13, 14 and 15 months, milk production goes on for 40, 42, 44 and 47 weeks respectively. These data enabled the author to complete the report of GARVIN who only continued his observations up to the 37th week of milk production. GARVIN found that the milk yield of cows that had been re-mated began to decrease from the 24th week preceding calving.

Taking into account the date at which the milk yield decreases, the

following figures were obtained for the lactation periods of different lengths ; in order to obtain the normal yield, 90 litres must be added to the actual yield in the case of an 11 months lactation period, while 157, 292 and 405 litres must be subtracted from the yield of lactation periods lasting respectively 13, 14 and 15 months. These data are confirmed by the Ayrshire cow returns for 1913, 1919 and 1920 which have been published by the Scottish Milk Records Committee.

F S.

216 The Meat Yield of Charollais Cattle.

LAPLAUD, M. and DEGOIS Le rendement des Bovidés. Le bétail Charollais à l'abattoir de Cantarane *Revue de Zootechnie*, Year 2, No. 1, pp. 25-32, figs 2. Paris, 1923

The " Union Charollaise et Bionnaise " sent to Rodez twelve Charollais animals which were slaughtered at Cantarane. This afforded a good opportunity to determine the meat yield of cattle that have been transported a long distance and to compare the dressing qualities of the Charollais and Aubrac breeds.

The consignment consisted of : 2 old cows ; 2 cows that had completed their 5th year, 3 three-year-old steers, 3 four-year-old steers and 2 five-year-old steers. The animals had not been specially prepared for the experiment and thus represent the average of an ordinary lot of butcher's beasts. The cattle were sent off by train at 4 a. m. on June 5 and arrived at Rodez at 7 a. m. They were weighed before being put in the trucks and on their arrival at Cantarane.

Total variations. — These 12 head of cattle consisted of two lots, one of which had been bought at a fair and had been turned into a strange meadow for some days before being despatched to Rodez. The second lot came direct from a field near the Marcigny Station and had only walked a few kilometres the day they travelled.

If the net weight is compared with the weight at departure, the dressing yield of the first lot was 59.2 % and that of the second 54.2 %, but if the net weight is compared with the weight at the time of slaughtering, the respective returns were 65.5 % and 62.5 %. The total weight of the lot bought at the fair was 4397 kg. at its departure ; the amount lost, during the journey was 429 kg. The meadow lot weighed 4144 kg. before it left, and lost 544 kg. The live-weight loss entailed an increase in dressing-yield of 6.3 % and 8.3 % respectively.

The difference in the loss in weight of the two lots (9.7 % for the first and 13.1 % for the second) can only have been caused by the conditions previous to their entraining. The result of this difference, 3.4 %, is due to fatigue.

It seems, therefore, that the loss of weight is less during the earlier days of transit than later. This difference is at first due probably to the assimilation of the food substances present in the stomachs ; for the decrease in meat weight would only begin as soon as the reserve stock of available food was exhausted. The precise moment at which this takes

place is difficult to determine. It can only be concluded that the decrease in weight is not regular, but will be least during the first days of the journey.

Individual variations. — Cow No. 5 of 14-15 years of age; slightly built, weighing 288 kg. net weight. This animal lost about $\frac{1}{6}$ of its live-weight between the two weighings which increased its yield 10.5 %.

Cow No 6, was the same age as No. 5, but more heavily fleshed and weighed 368 kg net, and lost less between the two weighings, so its return was only increased 7.1 %. It should be noticed that the latter cow belonged to the fair lot, whereas the former belonged to the meadow lot. This large loss of weight almost always occurs in the case of old cows whose digestive canal contains enormous masses of food substances.

On the other hand, strong animals in good health lose the least weight.

Of the 12 oxen, the finest were No. 9, a castrated animal 3 years of age, and No 11 aged 5 years. They lost least weight between the two weighings and their increased yield was respectively 6 % and 5.3 %.

These facts show the yield of an animal to be a function of its conformation and condition of fatness on the first place, but it also depends to a considerable extent upon the conditions under which it has been living during the days before being slaughtered.

The authors have investigated the distribution of the meat in one animal from each of these 2 categories, and have made comparisons on this point between the Charollais and Aubrac breeds, taking for the purpose a steer belonging to each; the results obtained were as follows.

Charollais, 160 kg

Globe	kg	
Sirloin	46 "	kg 74 = 46.1 %
Ribs	14 "	
Under sirloin	5 kg	
Shoulder	6 "	kg 35 = 21.8 %
Shoulder-bl.	24 "	
Legs	12 kg.	
Chest	21 "	kg 17 = 20.6 %
Collar	13 "	
Head	15 "	
	1 kg	= 2.4 %

Aubrac, 170 kg

33 kg	
27 "	kg 74 = 43.7 %
14 "	
4.5 kg	
8 "	kg 40.5 = 23.9 %
28 "	
13 kg	
22 "	kg 52 = 30.7 %
15 "	
2 "	
3 kg	= 1.7 %

The variations in net weight according to age were as follows for the Charollais steers 3 year-old steers 322 kg., 322 kg., 393 kg.; 4 year-old steers: 434 kg., 439 kg., 442 kg., 5 year-old steers 534 kg., 558 kg.; 2-year old cows 368 kg., 398 kg., old cows 288 kg., 361 kg.

The authors also mention a boning experiment made by RIBOUD which showed the proportions of meat, fat and bone in a hindquarter of a Charollais ox to be as given below

Weight of hind quarter

Fat	140	= 14.64 %
Detached bones	20.500	
Bones left with meat	15.500	12.5 %
Meat	102	= 72.85 %

The bone in a hindquarter of a Charollais ox weighs therefore 12.5 % of the total weight. According to Prof. DECHAMPRE, the average weight of the bones of a fat animals is from 16 to 16.5 %. Thus, the proportion of bone is higher in the fore-quarter than in the hindquarter. F. S.

247. Cattle Breeding Possibilities in South Africa.

DUERDEN, J. E. *The Farmer's Weekly*. Vol. XXIII, No. 595, p. 1926. Bloemfontein, 1922.

Only in limited areas does any variety of stock reach perfection of development, and maintain it for successive generations. Very often a breed attains maximum development in its native country. This holds good in Africa in the case of Bovidae. Hence the natural conditions may be considered very favourable to cattle rearing in general.

The indigenous cattle can be shown to have possibilities equal to those in any part of the world, while the recent exportation of Frieslands from South Africa proves that breeds raised elsewhere will maintain, if not exceed their maximum of development in the other areas.

F. S.

248. Karakul Sheep Breeding in the United States.

YOUNG, C. C., Practical Tests in Karakul Sheep Breeding. *The Journal Heredity*, Vol. XIII, No. 5, pp. 228-236, fig. 3, Washington, 1922.

The Karakul sheep can raise its head to the same level as a cow, and is thus able to reach the fruit of many kinds of shrubs and weeds. It has very strong teeth and the mucous membrane of the mouth is very rough.

A test made for a period of several months at El Paso (Texas) shows that the Karakul sheep fattens as rapidly on a poor, dry pasture as a merino fed on lucerne and maize.

On March 20, 1920, four rams were tested on behalf of the United States Bureau of Forestry, being allowed to feed naturally by nibbling the bark of oak tree., willows, "manzanitos" etc. and browsing on clover grass. On May 11, 1920 the rams were shorn and weighed, and weighed a second time at the end of August with the following results:—

	May 11, 1920		August 31, 1920	
	Weight of fleece	Weight of shorn ram	Weight of ram	Gain
	lb	lb	lb	lb
No. 1	10	147	213	66
" 2	8	141	178	37
" 3	10.5	130	172	42
" 4	11	101	141	40

The fleece shorn on May 11, 1920 was 6 months old and the wool contained no grease and did not require washing, which in the case of the merino causes the wool to lose 50 % of its weight.

The flesh of the Karakul has a different flavour from that usually

characteristic of sheep and resembles venison. In Central Asia the fat takes the place of butter and is used for cooking purposes.

Crossing a thick fleeced domestic ewe with a good type of Karakul ram often produces lambs, whose fleeces are as valuable as those coming from pure-bred sheep. The writer has ascertained that in practice such crossing gives about 100 % of black and very early fleeced lambs. The ewes that are most suitable for crossing belong to the following breeds: "Najoo", black headed "Highlands", "Lairy Mexican Corriente", "Cotswolds", "Lincolns" and "Ahuris".

Since pure-bred specimens are now rare and those only, which have never been crossed with a fine-wool stock and are of sufficiently pure Dador origin, can reproduce lambs with glossy, black and curly fleeces, the writer is of opinion that those only should be considered as pure-bred whose offspring have actually given proof of such purity.

The author considers that the breeding of Karakul sheep can only be expected to be successful if exchanges are made of the comparatively few pure bred rams and the fine wool specimens are eliminated. He also calls attention to the publication in November 1922, of a monthly Review, "The Karakul Breeder" specially devoted to this subject F S

249 Sheep-Breeding and its Advantages.

STOW, H C P. Government Sheep and Wool Expert, Bloemfontein) Sheep Economics. *Journal of the Department of Agriculture* Vol. VI, No 11, pp 68-70 Pretoria 1913

The author points out the advantages of breeding sheep rather than other stock and the profits to be derived from them on mixed, or cereal farms. From the results of experiments, it would appear that sheep produce at 8, or 9 months of age as much meat and wool as are now yielded by a year-old animal, could easily be obtained by more intensive and systematic crop cultivation and by feeding a more nutritious ration to the stock. If the sheep were turned out on to "Steekgras" before it seeds, this troublesome plant could in a great measure be destroyed. S

250 Sheep Breeding for Export.

RIVERS, O. *Journal of the Department of Agriculture*. Vol. V, No 4, 330-336 Pretoria, 1922

The author first gives a survey of the present conditions of export trade of frozen meat in South Africa and Australia. The class of sheep that finds most favour and obtains the highest prices are those weighing from 56 to 64 lb. when fat, and for lambs, 36 to 42 lb.

In South Africa there will soon be a surplus stock, and rapidly falling prices, and an improvement in breeds will be necessary for the export trade. With this in view, the author suggests the crossing of Persian ewes and animals of unknown origin, found in the dry areas, with Suffolk rams. In this way in the progeny, the fat is more evenly distributed and the resistance of the cross-bred to ticks etc. is of distinct value.

At Potchefstroom, two Suffolk rams served 114 ewes, of which 26 were Persians, 40 first cross Suffolk-Persians, 25 third and fourth cross Suffolk-Persians and 23 cross Suffolk-Merino. The percentage of lambs dropped was : 129 from 102 ewes.

The following table gives the average weights of the lambs for the first and second crosses Suffolk \times Persian.

	1st cross	2nd cross
	lb.	lb.
9 weeks	38	40.5
14 $\frac{1}{2}$ "	52	56.5
19 $\frac{1}{2}$ "	62	63.5
23 $\frac{1}{2}$ "	68	70.5
27 "	80	85

The average weight of the carcass was 40 lb. The first cross showed a higher percentage of fat than the others.

The Suffolk-Merino lambs appeared to be more resistant to ticks.
F. S.

251. Breeds of Swine.

RUSSELL, E. Z U S. *Department of Agriculture, Farmer's Bulletin*, No. 1263, pp. 22, figs 18 Washington, D. C., 1922

Revision of preceding Bulletin (see *Farmers' Bulletin* No. 785 and R 1919, No. 346).

In the United States there are two distinct classes of swine. lard-type hogs and bacon type. The first are bred much more extensively throughout the States and include the following breeds: Duroc-Jersey, Poland China, Chester White, Berkshire, Hampshire, Spotted Poland China. The only bacon hogs bred extensively are the Tamworth and Yorkshire.

The type of animal is of far greater importance than the breed itself. Ham weighing from 12 to 16 lb. and bacon from 10 to 12 lb. more popular in the market, as they are likely to cure with high quality and flavour. Every hog raiser knows that the most profitable hog is the one which can be grown to the required market weight in the least possible time. This type exists in every breed, but in some breeds more frequently than in others.

Other desirable characteristics are: reaching the market weight at an early age (this is generally from 175 to 225 lb.); a good firm carcass; hams and bacon with a medium but not excessive proportion of fat to meet trade demands. Well-bred and well-fed animals of this type attain market weights at from 7 to 10 months of age; if the growth of a small-type hog is forced in order to reach market weights he will not only produce hams and bacon having too large a proportion of fat but to reach the required weight will generally have to be fed for a longer period.

Exercise is essential for the production of prolific breeding animals, and to maintain a big type animal, careful selection, proper feeding, and breeding from animals of proper maturity are necessary.

Within the last decade the lard-type hog has been changed to a con-

siderable extent in the United States. The low-set, broad block type of hog is now fairly upright, and has good length and depth with medium width. The shoulders should be full and smooth, not coarse; the hams full and as wide as the shoulders; flesh evenly distributed over the body.

The Duroc-Jersey breed was derived from mating strains of the Duroc red hogs (raised in the New York State) and the Jersey reds. This breed is also red in colour, and is noted for its hardiness and prolificness. Pigs of a good type weigh 200 lb. at 6 months of age; in breeding condition they may weight some 650 lb.; sows from 600 to 700 lb.; in show condition they may attain a weight of 1000 lb. There are two associations for recording hogs of this breed viz. National Duroc-Jersey Record Association, Peoria (Illinois) and the American Duroc-Jersey Breeder's Association, Union Stock Yards, Chicago (Ill.).

The Poland China hog originated in Butler and Warren Counties (Ohio), derived from the Moore and Magic breeds. During the last 15 years, the type has been much improved as regards weight; the boars have big heavy bones, well formed at an early age, and, if well fed may weight 200 lb. at 6 months of age.

The animals are either black or with white patches. Three Associations keep records of this breed: 1) American Poland China Record, 609 Transportation, Building, Chicago, Illinois; 2) Standard Poland China Record Association; 3) National Poland-China Record Association, Moorman Block, Winchester, Ind.

The Chester White breed had its origin in Chester County (Pennsylvania) in the early 19th century and is a cross between the Yorkshire, Lincolnshire and Cheshire hogs, all of English origin; the most successful cross was made with an imported hog from Bedfordshire. In 1884, the first record association was formed and later 8 others followed, but the popularity of the breed seemed to decrease, owing to the lack of uniformity. This breed adapts itself readily to environment, is well formed, is a good grazer, matures early and possesses good dressing qualities, it is similar to the preceding breed as regards size etc. The following record associations are recognised: Chester White Swine Record Association, Rochester (Ind.); O. I. C. Swine Breeders Association, Goshen (Ind.), and the National Chester White Swine Record, Wester Chester (Pa.).

The record association for the Berkshire breed is the American Berkshire Association, 510 East Monroe Street, Springfield (Ill.).

The Hampshire breed was introduced into the United States from England during the first half of the last century and has increased in popularity during the last 10-15 years. Colour, black with white, with belt round the body; flesh of good quality. The only record association is the Hampshire Record Association, Wisconsin Avenue Peoria (Ill.).

Spotted Poland hogs are found in many parts of the United States. It has a larger amount of white coloration (some 50% of the body) and may be described as white with black spots. The first record association founded in 1914 was the National Spotted Poland China Record Association, 602 Wulsin Building, Indianapolis (Indiana).

The Tamworth and Yorkshire breeds are the chief bacon types. The

first originated in Ireland and is established in many localities ; the second is confined chiefly to the Northern States.

The American Tamworth Swine Association, Carthage (Ill.) was organised in 1897.

The large and small Yorkshire breed records are kept at the American Yorkshire Club, 471 Fairview Inn, St. Paul, Minnesota.

In addition to these breeds, other minor breeds are mentioned : Mule-foot, Kentucky Red Berkshire, Cheshire, Essex Victoria and Large Black.

The Mule foot comes from a very ancient breed, probably of African origin ; medium size, black or with white spots. The National Mule-foot Hog Association Degraff (Ohio) was formed in 1908, and later the American Mule-foot Hog Record Co., 1105 Wyandotte Building, Columbus, Ohio.

Kentucky Red Berkshire, raised chiefly in Kentucky, resembles the common Berkshire but is red. The Kentucky Red Berkshire Swine Record Association, Richmond (Ky) was organised in 1913.

The Cheshire breed originated in New York State about 1885 and was the result of cross breeding Yorkshires and White Suffolk hogs ; white, medium size, good quality flesh. The Cheshire Swine Breeders Association Freeville (N Y) was organised in 1884.

The Essex hog was first introduced into the United States in 1820 ; it has not become very popular owing to its small size, and excessive amount of fat. The American Essex Association, New London (Iowa) was founded in 1887.

The true origin of the Victoria breed is not certain but may be a combination of the Poland China, Berkshire, Suffolk and Chester White, colour white ; medium size. The Victoria Swine Breeders Association, Dyer, Indiana was founded in 1886.

The Large Black is noted in England for its superior bacon. The Ottawa Agricultural Experiment Station Canada, claims however, that this breed is not equal to Tamworth or Large Yorkshire. The records are kept at the American Black Pig Society, Lexington, Kentucky.

F. D

252 The Relative Growth and Development of Various Breeds and Crosses of Pigs.

HAMMOND J (Institute of Animal Nutrition, School of Agriculture, Cambridge) *The Journal of Agricultural Science*, Vol. XII, Part 4, pp. 387-423, 21 tables, figs 5, bibliography. Cambridge, 1922

The author's objects are to show the capacity for live-weight increase possessed by the different breeds of British pigs and to give in the case of each the proportion of meat and offal in their carcasses.

Most of the data refer to the following breeds : Small White ; Middle White, Large White, Large Black, Berkshire, Tamworth, Lincolnshire Curly-Coated, Dorset, Small Black and Somerset (Gloucester Old Spots).

Nearly all the studies hitherto made of the growth and development of domestic animals have been based on the chemical composition of

the body, no distinction being drawn between those portions that have a different value from the financial and food points of view.

In this work, the author has made use of the information collected by the Smithfield Club on the occasion of the show of fat stock that was held at Islington (England) every year from 1903 to 1913. At these shows there were two sections for pigs: the Live Pig Section and the Dressed Carcass Section. In the first, only the age and total weight of the animals were taken into account, but in the second section the weight of the carcass and of the pluck were also considered. In neither section was any sex distinction made, it indeed appears that the differences between the male and female pig are unimportant. Only fat stock was entered for this Show, therefore the figures quoted are very high averages applying to the finest specimens, which does not, however prevent the value of each race being very accurately gauged for purposes of comparison. Further, in order to prevent too great deviations, the author considers the figures referring to pigs in the classes, and to those shown separately.

The growth and development of pigs may be modified by different factors, hence the author classified the results obtained according to the influence of breed, age, early maturity, crossing, selection, individual variation and correlation.

BREED. — So far, no satisfactory explanation has been offered of the fact that some breeds of pigs produce meat at less expense than others. It would appear that breeds differ in their capacity for turning to account the food they consume and not in the actual amount eaten.

In the first table, the author gives the average weights and ages of the pigs entered in the Live Pig Section. In the second table are to be found the average weekly live-weight increase of the various breeds at different ages. The following are some of the data for 4 breeds:

TABLE I — *Live Stock Section*

Age (months)	3	5	7	9	11
	lb.	lb.	lb.	lb.	lb.
Large White	7.2	5.4	—	10.8	10.9
Large Black	—	—	10.9	10.3	10.7
Berkshire	7.1	5.8	7.8	9.4	9.1
Middle White	6.5	6.4	7.5	9.0	8.7

In the third table, the breeds are classed according to weight at the age of 11 months. The *Worcester* Curly-Coated breed takes the first place with an average weight of 510 lb., after it come the Large White av. 481 lb.; Large Black av. 470 lb., Tamworth av. 414 lb., Berkshire av. 402 lb., and Middle White av. 384 lb.

The average weights of the animals slaughtered for the Dressed Carcass Competition are given in Table IV, while Table V shows these figures converted into weekly increase of live-weight.

The live-weight in lbs. of the 4 chief breeds in the Dressed Carcass Section are given below :

TABLE II (VI)

Age (months)	3	5	7	9	11
	lb.	lb.	lb.	lb.	lb.
Middle White	59 8	94 1	192 8	282 6	283 1
Berkshire	73 1	102 2	175 1	231 9	248 4
Large White	67 4	124 5	230 4	260 1	234 7
Large Black	80 6	111 2	216 4	243 8	260 1

In the above table, the breeds are classed in order of weight at the same age.

The carcass weight of the same breeds represents the following percentages of total live-weight

TABLE III (VII)

Age (months)	3	5	7	9	11
Middle White	74.3	76 8	82 4	84 0	85 2
Berkshire	77 0	78 7	81 1	82 5	83 1
Large White	73 0	76 9	80 0	81 3	83 5
Large Black	72 9	73 9	79 7	80 3	80 7

From Table VII, it appears that when the percentage weight of the carcass increases as compared with the total live-weight, the percentage weight of the pluck decreases.

On comparing the live-weight of the animals in Table III with that of the animals in Table VI it is found, all other factors being equal, that the pigs exhibited in the Live Stock section were heavier than those exhibited in the Dressed Carcass Section. The author is of opinion that this difference is probably due to excess fat which is of no value to the butcher. It is very noticeable that this difference was only 44 lb in the case of Tamworths which belong to a breed that rarely puts on extra fat. At the age of 3 months, the difference in weight between the breeds in the two sections was 16 %, and at the age of 11 months it had reached 62 %.

AGE. — The effect of age on the increase in weight of the various breeds calculated in lb. increase per day since birth, is shown in Tables II and V. From an examination of the data given it can be seen that all the breeds do not attain maximum development at the same age. Middle Whites and Berkshires (noted pork producers) come to their full size sooner than Large Whites and Large Blacks (reared for bacon), but they grow less between the ages of 9 and 11 months than the pigs of the two latter breeds. There is no connection between increases in live-weight

and in meat. From the age of 9 months, the latter bears no proportion to the increase in total weight which is caused by a larger formation of fat.

The author has also calculated the amount of growth between the two given ages by subtracting the weight at age x from age y , and the number of months at age x from the number of months at age y .

This was done for the 4 breeds, and the results obtained are set out in Table VIII and diagrammatically represented by the following figure.

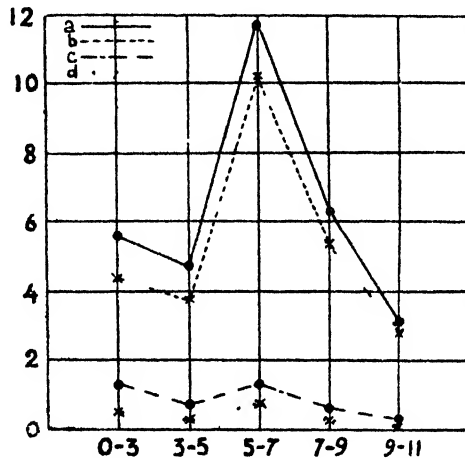


FIG. 56. — Amount of Growth between the two given ages

According to Table VIII, at the age of 3 months, the carcass represents 74.3 %, the pluck 5.8 % and the intestines 19.9 % of the total increase in live-weight, whereas at the age of 9 to 11 months, the percentages are respectively 5, 3.2 and 2.3. This difference in the relative composition of the older and of the very young animals shows that earlymaturing breeds of pigs should be selected for pork and bacon production. The author believes that the percentage of carcass depends upon the actual weight of the animal and is little influenced by its age.

EARLY MATURITY. — In order to estimate the degree of maturity of an animal at any given age, it is necessary to compare its live-weight at that age with the live-weight of the animal when mature, the percentage of the carcass as compared with the total weight at the different ages, and the amount of fat and muscle in proportion to the amount of bone in the carcasses.

Table IX shows the live weights, in percentages of the live weights at the age of 11 months, of the various breeds at different ages. According to these figures, the Middle White is the breed that matures earliest. It is very closely followed by the Berkshire, after which comes the Large White and the Large Black is the last of all.

The following diagram shows the relative early maturity of the 4 chief breeds, as regards the second factor (carcass percentage).

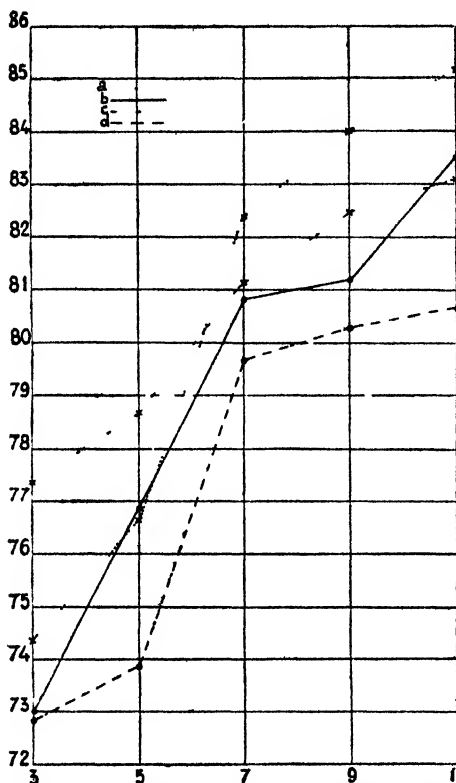


FIG. 57 — Carcass Percentage at Different Ages

In Table V, the degree of maturity is calculated from the weight of the different parts (carcass — pluck — intestines) at different ages as compared with the weight of these parts when the animal is 11 months old.

The author had not sufficient material at his disposal to enable him to determine the precocity of the different breeds as regards the third factor (amount of fat and muscle)

CROSSING — The average weights and ages of all the cross-bred pigs shown at Smithfield from 1901 to 1913 are given in Table XI. In Table XII, the weights of the animals have been converted into live-weight increase per week. Table XIII gives the weight of these hybrids at the same age, and in the opposite column, are entered the average weights at the same age of the animals used in the crosses.

The hybrid pig often weighs more than the heavier of its parents (Berkshire × Middle White and Berkshire × Tamworth, and in most of

the crosses Berkshire \times Large White). When there is a great difference between the weights of the two animals crossed, the weight of their offspring in many cases exceeds the average of the parents. In one case alone (Berkshire \times Lincoln Curly-Coated) is the weight of the hybrid regularly less than the average weight of the parents.

Crossing has been found to increase the vigour of the offspring as well as their size.

On crossing the Berkshire with the Large White breed, it was found that the progeny of the Berkshire sow were smaller at first than the offspring of the reciprocal cross, but this difference was not persistent. The author believes that early development is due to a sex-linked factor, for the same difference in the size of the piglings was noticed when Berkshires were crossed with Tamworths, or Lincoln Curly-Coated pigs; although, when both parents belong to an early-developing breed the precocity of their offspring is not increased.

Table XIV shows the degree of maturity of the different hybrids at various ages by comparing their weights then, with their weights at the age of 11 months. The figures prove that crossing not only increases the weight of the hybrids, but also causes them to mature earlier.

The weights of the carcasses of the hybrid pigs of the same age are to be found in Table XV. The pure-bred and cross-bred pigs exhibited in the Live Stock Section were heavier (especially when they were old) than those in the Dressed Carcass Section.

Table XVI gives the proportions of the weight of the carcass, the pluck and the intestines of the hybrids as compared with the weight of these animals. If the data of this Table are compared with those of Table VII it is seen that the highest degree of early maturity is obtained by crossing an early breed with a late one, or by crossing two breeds which do not mature early. If two early maturing breeds are crossed, the offspring do not mature earlier than their parents. These conclusions must however only be regarded as of relative value.

SELECTION. — In Table XVII, the author gives the weights of pigs belonging to the Large Black, Large White, Middle White and Berkshire breeds. The data are divided into two periods, one from 1901 to 1906, and the other from 1907 to 1913. In this way, it is possible to estimate the effect of crossing on development as demonstrated by the differences of weight of the animals of the same age which were shown during one of the two periods. It is seen that at the age of 11 months, the Large Blacks had increased on an average 70 lb. the Large Whites 50 lb., the Middle Whites 30 lb., and the Berkshires 5 lb. The author is however of opinion that these increases in live-weight are to be attributed to the presence of a larger amount of fat.

Of the pigs shown in the Dressed Carcass Section, the Berkshires alone were sufficiently numerous to allow of any comparisons being made between the two periods, therefore the figures given in Table XVIII refer only to this breed.

INDIVIDUAL VARIATIONS. — In addition to the well known factors causing variations in the weight of any animal, there are also others whose

effects must be included under the head of individual variation. One of the most important of these factors is the presence of food in the digestive canal, this can make a difference of 2 to 11 % in the weight of an animal. In order to estimate this variation which may affect the different breeds at different ages, type deviations (given in Table XIX) have been determined for each. This variation is less in the hybrids than in the pure-bred pigs, and attains its maximum when daily growth is greatest.

Table XX gives the type-deviations and the growth variation coefficient for the various parts of the body in the case of Berkshire pigs of different ages. In these animals, the variability is highest when the change in the proportion of the carcass is highest.

CORRELATION. — In order to determine the effect of weight independently of age, upon the proportions of the body and also the correlation existing between the proportions of the different parts of the body, the author drew up Table XXI, an examination of which shows that for a given breed and age, the proportion of the carcass to the live-weight will be largest when the live-weight is greatest. The carcass percentage varies inversely to the percentage of pluck and intestines. If their ages are equal, a large animal will produce meat more economically than a small animal.

F. S.

253. Cacao Hulls as a Swine Feed.

VEZZANI, V. L'uso alimentare delle bucce di cacao, Prima contribuzione sperimentale dell'alimentazione dei suini. *Istituto zootecnico per il Piemonte (Lucento)*, Series B, No 1, pp 31. Turin, 1922.

The hulls, or shells, of cacao are an important residuum of which the world's production rose in 1917 to about 3400 000 quintals. The author estimates the annual Italian output at 4 200 quintals, but most of it comes from Piedmont. The results of several analyses given by the author show these hulls to be fairly rich in crude nutritive substances, in which respect they may be compared to wheat bran. There are, however, great differences in the figures obtained by the various analyses, which discrepancies seem to be due to the origin and the state of preservation of the product.

The author mentions numerous feeding tests carried out in various countries with rations containing cacao hulls, the animals used being horses, cattle and sheep (1). The results were generally good, though some cases of poisoning were reported when too large quantities were given.

In Italy, cacao-hulls have been fed experimentally by FAELLI, to 9 dairy cows (of the Dutch, Schwyz and Parmegian breeds). The hulls were fed up to the rate of 3 kg. per head and per day, mixed in different proportions with bran, and fed with a basal ration of lucerne hay from a natural meadow. The animals ate them readily, while a slight

(1) See R. 1913, No. 156; R. 1917, No. 740; R. 1918, No. 992; R. 1920, Nos. 217 and 548. (Ed.)

increase in the milk yield and an improvement in the composition of the milk was observed. FAELLI therefore recommends cacao hulls as a nutritious and economic adjunct to the rations of milch cows. The amount given must not, however, exceed 3-4 kg. per head and per day, as larger quantities might easily induce diarrhoea.

Cacao hulls can be fed raw, or roasted, according to whether or not they have been separated from the seeds before the latter have been roasted. Those used by the author had been roasted; their percentage composition was as follows: water 9.61 — protein substances 17.90 ether extract 11.02 — nitrogen free extracts 36.59 — crude fibre 16.25 — ash 8.63 — theobromine 0.30. The alkaloid content was thus low.

Five young castrated pigs were used in the experiments; 4 Yorkshires of about 5 — 4 — 4 — 3 months respectively and having an initial weight of 50—40.8 — 38.5 and 21.4 kg. and one 2 ½ months' old Tamworth with an initial weight of 17.5 kg. The basal rations consisted of fine bran and maize meal to which were gradually added increasing amounts of cacao-hulls (from a minimum of 50 to 300 gm. per head and per day to a maximum of 100 to 400 gm). The proportions of cacao-hulls fed to the different animals were slightly different, varying from a minimum of 3.5 % of the ration (raised gradually to 9.7 %) to a maximum of 8 % (raised gradually to 16.65 %). The young pigs were also allowed to graze. They made satisfactory increases in live-weight, viz., 670-640-500-400 and 350 gm. per head and per day. The least increase was in the case of the animal given the largest amount of the cacao hulls; this pig began by showing distaste to the hulls and finally sickened and died. The post-mortem revealed rupture of the intestine resulting in acute peritonitis.

The author concludes that cacao hulls, when roasted and ground, are readily eaten by swine if mixed with other foods in proportions not exceeding about 5 to 6 %. The palatableness of the hulls diminishes as the amount fed is increased, distaste and nausea being produced if the quantity exceeds 10-12 %. Even 6 % may cause symptoms of intolerance and sufficient to induce serious disturbances of the digestive system, or even death. Cacao-hulls being very aromatic, are especially suited for flavouring other foods and rendering them more appetising.

F. D

254. Selecting and Rearing Brood Sows.

Live Stock Journal, Vol. XCVI, No 2538, p 520. London, 1922.

Young pigs should receive an abundance of milk if the sow is to be a good milker later. Spring and summer litters are preferable from which to select brood sows. In the cold weather, care should be taken not to give them too much corn or other fat-producing food. It should be borne in mind, that at this period the animals naturally store fat, which afterwards goes to enrich the milk. Hence they should be fed in such a way that the demands of nature are supplied and their general health and vigour are maintained, but at the same time they should not be allowed to become excessively fat.

After the first litter, cooling drinks and very little rich food will be

sufficient for the first 5 or 8 days. In 10-15 days the richness may be increased gradually. It is not until the pigs are some 3 to 4 weeks old that the sow should be fed liberally on good nutritious milk-producing food.

The importance of careful attention of brood-sows with their first litters is emphasised. F. S.

Poultry

255. Toe-Pecking in Chickens.

GRASHUIS, J. "Teenen Pikken" by kuikens. *Tijdschrift voor Diergeneeskunde*, Part 50, p 43-44, Utrecht, 1923.

During the summer of 1922, the author undertook the treatment of 150 pure-bred White Leghorn chickens only a few days old. He found the sick birds to have all lost part, or the whole, of one toe, while one toe was missing on the feet of those that had succumbed to the disease. Sometimes, the tail also was injured. It was very noticeable that all the birds thus affected had been in the habit of pecking their toes.

After trying various remedies, the author finally gave the chicks per head and per day 50 mgm of "phosphone" dissolved in 200 gm. oleum jecorisaselli, 100 gm. of chalk and 50 gm. of kitchen salt.

The results obtained were very satisfactory, as after 5 days, the disease entirely disappeared. The treatment was continued for 10 days, and one month after it began, there was no sign of any recurrence of the malady. F. S.

256 Ovaritis with Ovarian Rupture in Laying Hens.

DEGOIS, E. (Vétérinaire du Centre National Zootechnique de Vaulx-de-Cernay) *Revue de Zootechnie*, Year 2, No 1, pp 73-78, fig 1 Paris, 1922.

The greater number of the deaths among fowls during egg-laying competitions are due to a lesion of the genital organs caused by the rupture of one of the most mature ova which is generally still in the ovarian cluster but may already have passed into the oviduct. The ovum may break at any stage in its development, and usually causes instantaneous death of the hen. The disease does not appear to be infectious.

From the examination of the hens that died during the egg-laying competition at Vaulx-de-Cernay in 1921 and 1922, it seems clear that ovaritis only occurs during egg-production, making its appearance as soon as laying begins, reaching its height during maximum egg-production, and diminishing as egg-laying decreases. This disease therefore attacks laying fowls, and especially at the beginning of egg production.

The activity of the ovary is stimulated and maintained during egg-laying competitions by a ration with a narrow nutritive ratio which keeps the ovaries in a state of constant hypercongestion, but if congestion of the ovary is the cause of ovaritis, it might be supposed that the affection would be of more frequent occurrence when the fowls were liberally fed and could be prevented to some extent by reducing the rations. The author, however, considers high feeding to be necessary during egg-laying competitions and

that one of their chief objects is to discover which fowls are most resistant to ovarian rupture.

The author's conclusions have been confirmed by a study made at the same time by BEACH in California. F. S.

257. **The Chantecler Breed of Fowls.**

COLE, L. J. (University of Wisconsin, Madison). *The Journal of Heredity*, Vol. XIII, No. 4, pp 147-152, figs 3 Washington, 1922.

The name Chantecler has been given to a new race of fowls bred at St. Anne de Bellevue by Brother Wilfrid, the Trappist Monk in charge of the poultry breeding section of the Oka Agricultural Institute (Prov. of Quebec). One of chief merits of the new breed is its power of withstanding the cold winters of a northern country. Characteristics: a dual-purpose bird (good layer and table-fowl), lays eggs even in winter; plumage short, thick and white; comb and wattles reduced, for these appendages soon alter as a result of severe cold. The Cornish fowl was chosen as the point of departure for selection, as this bird possesses in a high degree the desired conformation, vigour and type of comb and wattles. In order to obtain good laying qualities, the Cornish breed was crossed with the White Leghorn, winter egg production being secured by an admixture of Rhode Island Red, Wyandotte and Plymouth Rock blood. The first crosses were made in 1908, with a dark Cornish cock and a White Leghorn hen on the one hand, and a Rhode Island Red cock and a White Wyandotte hen on the other. In 1909, the whitest hens of the first cross were mated with a fine white cock of typical Wyandotte type obtained from the second cross. In 1910, the hens of the preceding generation which were nearest the desired type were mated with a handsome White Plymouth Rock cock weighing $9\frac{3}{4}$ lb. The selection was continued for 2 or 3 years after the colour had become almost uniform, the egg-production greatly increased and the combs and wattles had begun to shrink. The hybrids were very strong and active.

In 1913, the flock was divided into two branches; in one a limited amount of inbreeding was practised, while in the other, the hens were mated with a Wyandotte cock. As was to be expected in such a recently-created and complex breed, a certain degree of variability still exists, but the characters were sufficiently fixed for the breed to be recognised by the American Poultry Association in 1920. The author gives the standard adopted by the Association of Breeders of the Canadian Fowl Chantecler. The typical weights are: 9 lb. for the cock; 8 lb. for the cockerel; 7 lb. for the hen; $6\frac{1}{3}$ lb. for the pullet. F. D.

258. **The Use of Germinated Oats and Barley as a Feed for Laying Hens.**

LENENDRE, G. (Agricultural Engineer). L'Utilisation de l'avoine et de l'orge germées dans l'alimentation des poules pondeuses. *La Revue Avicole*, Year 33, No 2, pp. 57-59. Paris, 1923.

Green food is a necessity in winter if fowls are to keep their health. It can be fed, however, in the form of germinated seeds, especially oats and

barley ; in this manner, the poultry obtain at the same time all the benefits of a grain ration. Oats are generally employed for this purpose. The chemical composition of germinated and ungerminated oats respectively is given in the following table.

	Germinated oats		Ungerminated oats	
	% of crude product	% of dry matter	% of crude product	% of dry matter
Water	75.9	—	13.3	—
Nitrogenous substances . . .	13.2	13.3	10.3	11.9
Fat	1.3	5.4	4.8	5.6
Carbohydrates	6.3	68.0	58.2	67.5
Fibre	2.5	10.4	10.3	11.9
Ash	0.8	3.3	2.8	3.3

A germinating apparatus is very easily made, for it consists essentially of a stand upon which several lattice work trays can be placed one above another like drawers. Four deal uprights 4 cm., or 5 to 7 cm., broad and from 1.80 m. to 2.10 m. long are placed at each corner and firmly fixed. Every 30 cm. up these verticals are placed horizontal bars of 25 mm. × 50 mm. upon which the trays slide. The latter are 60 cm. wide and 50 mm. deep, their sides are made of boards about 25 mm. × 50 mm. and at the bottom are strips of wood 12 mm. in width, placed at intervals of 3 mm. and securely fixed to the frame. These trays which are exposed to the continual moisture of the germinating oats must be of hard planed wood, although the frame can be of deal.

Six and a half litres of oats of good quality are placed in a sieve and over them are poured 6 ½ litres of tepid water, the temperature of which should be a little under 38° C.

In order to prevent the growth of moulds, a small teaspoonful of formalin should be added. After 48 hours as a maximum, the oats can be spread on the lower tray of the stand described above. The layer of seed ought not be more than 25 mm. thick in order to avoid any injurious rise in the temperature. Then the whole apparatus must be placed near the window of a well-ventilated room having a temperature of 16°-20° C.

The oats are well sprinkled twice a day with water at the room temperature. The day after it has been placed in the stand, the first tray is moved to the second shelf, and another put in its place. Each tray thus moves up a shelf higher every day. Until the seedlings have reached the length of 3 mm., the oats should once a day be moved about to allow the seed to germinate readily. After the seedlings have attained this size, it would be disadvantageous to disturb them.

By the time the tray reaches the top shelf, all the seedlings ought to be 10 to 12 cm. long, and may then be fed to the hens. If they are allowed to grow beyond 15 cm., the food supply of the seed is exhausted.

In a heated germinator, the number of shelves may be reduced to 4 and the oats can be given to the poultry on the fifth day (one day of soaking and 4 of germination).

One kg. of oats give 3.5 kg. to 3.6 kg. of germinated grain. With the 11 kg. of germinated oats that can be obtained every day from trays of the size described, the ration of 500 fowls can be supplemented, as they must not be fed more than 20 gm. of oats per head and per day. A larger amount might cause diarrhoea, while if as much as 50 gm. are given this feed is actually dangerous to the birds.

The apparatus must be disinfected after use; the author recommends for the purpose a 5 % solution of formalin, which effectually prevents any growth of moulds on the trays.

Barley when treated in this manner absorb the same amount of water, but takes longer during the process.

The optimum temperature for germination varies slightly in the case of barley and oats respectively, as is shown by the following table

	Germination temperatures		
	minimum	optimum	maximum
Oats .	4-5° C	25° C	30° C
Barley	3-4° C	20° C	28-30° C

At the same temperature, barley germinates quicker than oats

	Temperatures			
	4° C	10° C	15° C	20° C
Oats .	7 days	3 3/4 days	2 3/4 days	2 days
Barley	6 "	3 "	2 "	1 3/4 "

F S

259. Nettles as a Food for Chickens

MOLLO, A Osservazione sull'impiego dell'ortica nell'alimentazione dei pulcini, *Stazioni sperimentali agrarie*, Vol LV, Pts 10, 11, 12, pp 490-496 Modena, 1922.

A report of an experiment lasting 65 days with two lots of 6 chickens, each fed respectively as follows 1) crushed meal 10 3 kg + nettle 9 8 kg + maize (total starch value 15 72), 2) (control), a similar ration, but with clover substituted for nettle (total starch value 14 92 kg.) The total increase in live weight for lot 2 was 3 222 and for lot 1. 3.002 kg This indicates the value of nettle feed for chickens.

F D.

260. Fattening Poultry for Table Purposes.

NASH, E W (Assistant in Poultry, Grootfontein Schools of Agriculture). Fattening Poultry for Table Purposes *Journal of the Department of Agriculture*, Vol. V, No. 5, pp 447-448, 1 table. Pretoria, 1922.

The author made an experiment in fattening cockerels, using only the kind of food that every poultry keeper is likely to have on hand. The

birds used were particularly poor specimens. Their ordinary food was about 2 oz. of bran and pollard mixed with a percentage of meat meal in the morning green food *ad lib*, at mid-day and at night about $1\frac{3}{4}$ oz. to 2 oz. of mixed grain.

For the period of the experiment, which lasted eighteen days, they were kept in the fattening coop and each received per day $3\frac{1}{2}$ oz of common mealie meal and pollard (3 parts of meal to one of pollard) mixed with enough separated cream to make a thin paste.

The cockerels were starved for the first 24 hours after being placed in the coop, and afterwards were fed twice a day, but were given no drinking water or green food. The following table shows the results obtained with the birds used in the experiment, and with the control birds which were fed on the ordinary diet.

Weights and increases in weight of the birds in the experiment and of the control birds.

Breeds	Average weight at beginning of the experiment		Average gains after 18 days	
	lb.	oz.	lb.	oz.
9 White Leghorns	3	11	1	2
2 Control birds	3	8	nil	
4 Black Leghorns	3	$15\frac{3}{4}$	1	$7\frac{1}{4}$
1 Control bird.	3	7	2	
5 White Orpingtons	4	$7\frac{1}{2}$	1	14
1 Control bird.	4	8	2	

The birds in the experiment not only showed a much higher increase in weight but their flesh was of distinctly superior quality. F. S.

261. Some Remarks on Egg Production.

DAVEY E. J. (Harper Adams Agricultural College). Food in Relation to Egg Production. *The Journal of the Ministry of Agriculture*, Vol. XXIX, No. 8, pp. 745-748, 1 plate. London, 1922.

The poultry-keeper can increase his profits on eggs in two ways, either by decreasing the production expenses and asking more for each egg, or by increasing his production expenses and obtaining a larger number of eggs for sale.

So far, no data are available as to the working of the first method. The second has, however, been adopted at the Harper Adams College, and from the figures returned from November 1919 to October 1921, the author draws the following conclusions: 1) a correlation exists between the cost of the food given to the hens and the value of the eggs laid by them; 2) eggs do not fetch higher prices when the weight of food consumed by

the fowls is greater ; 3) there is very probably some connection between the quality of the food and the value of the eggs ; 4) in calculating the returns from a fowl, not only the value of the eggs she lays must be taken into account, but also that of the meat and manure she produces. F. S.

262. Turkey Breeding in Missouri (U. S. A.).

MCMAHAN, J. C How to Raise Turkeys in Missouri. *Monthly Bulletin of the Missouri Board of Agriculture*, Vol. 20, No. 9, p. 19. Jefferson City, 1922.

The author gives some advice, based on his own experience, on the subject of turkey-breeding. Four hectares of land are enough for one pair of turkeys ; 4 turkey-hens and one turkey-cock can be kept on 6 hectares, and 8 turkey-hens and one turkey-cock on 8 hectares. Fifteen turkey-hens can be allowed to run with one cock, but it is better to limit the number of females to 12. Turkeys should not be shut up, all they need is a shelter in which to take refuge in bad weather. The author used sodium chloride as a remedy against fleas in the birds, but if the parasites are very numerous, it is not sufficiently strong ; recourse must be had in such case to the following mixture ; carbolic acid 1 oz., coal oil 3 litres, tar oil 10 oz. This mixture is to be applied, after thorough shaking, to the inside of a box sufficiently large to contain a turkey-hen. One turkey hen is then put in, and the box covered with a sack. The sack can be removed after 20 minutes when it will be full of insects, while all those remaining on the bird will be killed. Turkey chicks cannot be treated in a similar way.

Turkey hens lay on an average 17 to 20 eggs, but by good feeding, the number can be increased to 25.

The eggs should be collected twice a day at the beginning of the season, by a person with clean hands. The author does not advise that the collector should wear gloves. The eggs are kept in a basket and should be turned once every two days.

Turkey-hens must have a varied diet if they are to lay well. If no green food is available, they may be fed lucerne meal, or ground clover meal, soaked over night. In order to have yolks of good colour, green food is absolutely necessary. The author attached much importance to the use of bran, oat meal, and wood charcoal which should be given *ad lib.* to the birds in addition to their daily ration. Charcoal purifies the blood and keeps the liver in good order. Hot food is not necessary, but if water is added to the ration, it should be warmed.

The turkey-hen begins laying at the end of February, or early in March. In order not to lose the eggs, it is well to affix a small bell to the birds neck, as then it can be tracked easily to its nesting place. It is advisable to notice what attracts turkeys that prefer laying outside the poultry-yard.

When many birds are kept, a shed should be built for them. The author's turkey-house is 14ft. long with boarding 4ft. high at the ends and wire-netting 7ft. 6 inches high in front. The shed is divided by movable partitions that can be replaced in bad weather by perches.

When it is impossible for a turkey-hen to sit where she has laid her

eggs, the author makes a nest for her in a barrel. Before putting the bird on the nest, it is best to fumigate it and powder it over with insecticide. After a week, the turkey-hen should be again examined for parasites as they attach themselves readily to the chicks.

The sitting turkey-hen should have always at its disposal some oatmeal, charcoal and water. Once a day, a little maize is fed.

When a turkey-hen becomes broody, she is put on 20 eggs in a nest, and at the same time, a setting of 9 eggs each is placed under 9 young turkey-hens. As soon as the eggs have all hatched, the chicks are given to the old turkey-hen. When the young birds leave the nest, they are treated with insecticide, and during the first 36 hours are given only a little sour milk to drink. The hen on the contrary, is fed liberally and is allowed plenty of pure water. The first food given to the young turkeys consists of hard-boiled eggs which are fed every 3 hours for the first four days, being gradually replaced by crushed oats and prepared foods. The chicks must not be let out in the morning before the dew has disappeared, and if they are caught in a shower must be put into a basket, covered with a cloth or sack, and put to dry near the fire. If any of the birds have caught cold, a little permanganate of potassium is added to their drinking water till they have recovered. Chicks attacked by diphtheria (*epitheliosis infectiosa avicum*) are treated as follows. A mixture is made of 2 oz. petroleum + 2 oz. sweet oil + 2 oz. turpentine + 2 oz. extract of camphor; this is well shaken and injected into the nostrils and upper part of the beak. This remedy is more effective if the birds head is dipped first into warm salt water.

The author believes that the disease known as Black-Head is produced by the consumption of spilt or fermented food, and that it might be prevented by giving the birds wood-charcoal *ad lib*. At the beginning of the breeding season, the turkey-cocks should be given, in addition to their ordinary food, some maize bread made according to the following recipe: 4 ½ litres of raw flour + one tablespoonful soda + 2 tablespoonfuls salt + 4 eggs. This is mixed with milk, put into a frying pan, and afterwards into a hot oven.

F. S.

BIBLIOGRAPHICAL NOTES.

- 263 PHILP, T. (Chief Government Veterinary Surgeon). *Common Diseases of Dairy Cattle and their Treatment. Department of Agriculture, Tasmania, Bulletin No. 107, p. 13, 1922.*

List of the principal diseases of milch cows in Tasmania and observations concerning the causes, symptoms and treatments. The treatments suggested are such as could be applied on a farm in the absence of a veterinary. The instruments advisable to have at hand for first-aid purposes, the useful drugs, and the exact value of certain current terms employed for dosing are mentioned.

F. S.

264. SINCLAIR, J. M. (Chief Veterinary Surgeon). A Short History of the Infective Diseases amongst the Domestic Animals of Southern Rhodesia since the Occupation. *The Department of Agriculture, Rhodesia, Bulletin* No. 435, pp. 30. Salisbury, 1922

The author gives an historical account of the following infectious diseases that have attacked the domestic animals of Southern Rhodesia: African coast-fever, contagious pleuro-pneumonia of cattle, rinderpest, foot-and-mouth disease, anthrax, blackleg (symptomatic anthrax), tuberculosis, epizootic abortion, three days' sickness, glanders, ulcerous lymphangitis, epizootic lymphangitis, and rabies. He adds a brief description of the measures that have been adopted for the control of these diseases

F. S.

- 265 BERNARD, M (Veterinary) Prophylaxis des maladies des animaux à la Guadeloupe (Prophylaxis of Cattle Diseases in Guadeloupe) *Journal de la Station Agronomique de la Guadeloupe*, Vol. II, No 3, pp 71-75. Pointe-à-Pitre, 1922

The author investigates the characters and the treatment of diseases which attack cattle in Guadeloupe. He also recommends measures of general prophylaxis which are too much neglected in that country. R. D

- 266 AUSTEN E. E. (Assistant-Keeper in the Department of Entomology, British Museum, Natural History), and HEGH (Chef de Bureau au Ministère des Colonies de Belgique) Tsetse-Flies, their Characteristics, Distribution, and Bionomics, with some Account of Possible Methods for their Control pp 188, plates 5, fig 19, bibliography. London, 1922.

This pamphlet by E. E. AUSTEN is not only an English translation of E. HEGH's summary (published in 1915) of all the facts then known about the tsétsé-flies, but contains many new facts and all the more recent data since collected on the subject of this formidable stock-pest. The pamphlet treats of: the general characters, general geographical distribution and classification of the tsétsé-flies; the distinctive characters and geographical distribution of the various species; the method of reproduction of the flies; the places and seasons at which it breeds; the zones where the various species are found; their distribution in the Belgian Congo; biological questions; the food of the tsétsé-flies; its connection with small animals and large game; the effect of external factors on the parasite; methods for destruction and control; preventive measures; ways of catching, keeping and studying the fly; ways of keeping and rearing the insects in captivity; method of dissecting the salivary glands; charts for showing the distribution of the tsétsé-flies; the principles that must be taken into account in studying the life-history of one species; and suggestions for further research.

F. S.

267. The Life-History of the Wire-Worm of Sheep. *Journal of the Department of Agriculture*, Vol. V, No. 4, pp. 326-329. Pretoria, 1922.

Life-history of the wireworm *Haemonchus contortus* and means of eradication. Two practical points are outstanding; — viz. that a pasture

may remain infested for at least a year; that a sheep may spread the infection so long as adult wireworm are present in the stomach. To successfully eradicate the worms, the treatment involves regular dosing at least once a month.

F. S.

268. GUTHRIE, J. B. Vitamines. *The Agricultural Gazette of New South Wales*; Vol. XXXIV, Pt. 1, pp. 53-57. Sydney, 1923.

A clear exposition of the facts connected with vitamins and their application to stock feeds.

F. S.

269. MAC NEILAGE, A., The Clydesdale *The Journal of the Ministry of Agriculture*, Vol. XXIX, No. 8, pp. 691-696. London, 1922.

The writer of this article describes the origin of the Scottish breed of draught horses known as the Clydesdale and gives an account of the way in which it has been developed. He mentions also the principal sires, showing in what way they influenced the characteristics of their descendants.

Clydesdales have always fetched the highest prices among draught breeds at public auction sales in Scotland and some notable examples are quoted.

F. S.

270. LEROY, A. Determination de l'identité des bovidés d'après l'empreinte de leur muflle (Identification of Cattle by means of Nose-Prints). *Comptes rendus des séances de l'Académie d'Agriculture de France*, Vol. VIII, No. 33 pp. 378-380 Paris, 1922.

By means of a process in which printing-ink was employed, the author succeeded in taking many prints of the striae present on the muzzles of cattle which he states are very useful for the purpose of identifying these animals. The question of the systematic use of this process is being studied by the staff of the Herd-Book of Seine-et-Oise.

F. S.

271. MAC MILLAN, A. A., and HOWARD, V. J., Dressing and Cutting Lamb Carcasses Lamb Rings. *Dominion of Canada, Department of Agriculture, Pamphlet, No. 8 New Series*, pp. 29- figs. 30 Ottawa, 1922.

Description of methods adopted for dressing and cutting lamb carcasses and distribution of the cut portions to the members of a Butcher's society.

F. D.

272. Standard du Lapin "Blanc de Hotot" adopté par la Société Française de Cuniculiculture *La Revue Avicole*, Year 33, No. 1, pp. 19-20. Paris, 1923.

The Standard of the "blanc de Hotot" rabbit as accepted by the Standard's Commission of October 1922.

It includes: breed characters, defects to be avoided, and scale of points.

F. S.

273. SÉVRETTE, G. Les Concours de Chiens de berger au Travail. *Revue de zootechnie*, No 15, pp. 504-509, figs 3 Paris, 1922.

The author describes the origin of sheep-dog trials of which the idea was conceived in England. The first of these competitions was held in Wales in 1873. After giving an account of the manner in which these tests are organised in Great Britain, he passes on to describe sheep-dog trials as they are held in France. One of these competitions took place in 1922 on the farms of Eure-et-Loire, the shepherd and dog being allowed to work under natural conditions. Although the author fully recognises the utility of this form of test, he thinks it should not be substituted for the usual type of competition. F. S

- 274 Standard for Blue Andalusians adopted by the "Andalouse-Espagnol-Minorque Club Français" — *La Revue Avicole*, Year 33, No 2, pp 60-61, figs. 2 Paris, 1923

The general characters of the cock and hen are here given together with the colour, plumage defects and the scale of points. F. S.

- 275 GORON, J and MORET, L Standard de l'oie de race Bourbonnaise *La Revue Avicole*, Year 33, No 1, p 23 Paris, 1923

Standard of the Bourbon breed of goose as established by the Bourbonnais Club. It includes: general characters, colour, characters tolerated, defects to be avoided, disqualifications and scale of marks. F. S.

- 276 GOUIN, R. La Production et le Commerce des Volailles, dans les Marais Vendée *Revue de Zootechnie*, No 14, pp 385-395, figs. 9 Paris, 1922.

This article begins with a geographical and economic account of the marshes of Vendée and describes the breeding of fowls, ducks, turkeys and geese in that district, as well as the manner in which they are killed, dressed and marketed at Challans, where frequently 10 000 head of different varieties of poultry are on sale. The author points out the defects in the methods usually adopted and the improvements that might be introduced. F. S

FARM ENGINEERING

Hydraulics.

- 277 Silt Dykes and the Utilisation of Running Waters.

TROUILLET, A., Digue de colmatage et utilisation des eaux courantes. *Direction Générale de l'Agriculture, du Commerce et de la Colonisation*, Year XXVI, No 108, pp 31-46, figs 6 Tunis, 1922

Barrage reservoirs along the course of a river have the great disadvantage of diminishing its flow, thus causing a large amount of the detritus carried by the stream to be deposited in the river-bed. The

[273-277]

author describes some methods adopted by himself during his long experience in districts where the enormous quantity of material transported by running water in times of flood actually impedes the progress of the local agricultural industry.

In this district, when the velocity of the water of the river in flood abates for any reason the detritus is deposited and gradually accumulates, until it forms a dam, often of a size sufficient to alter the course of the stream and make it overflow its banks and flood the adjacent land. If, however, below this dam a barrage reservoir were constructed, it would be completely cut off from the usual course of the stream, therefore the water could not be stored up and used systematically for agricultural purposes.

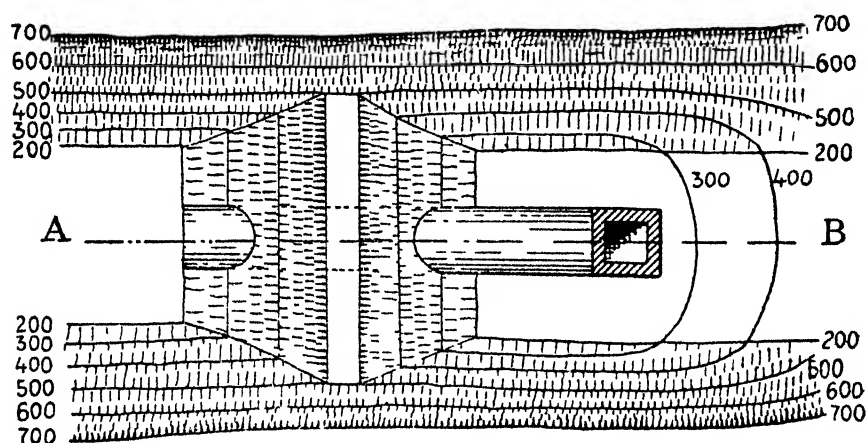


FIG 58 Plan of dyke

A-B = over-flow tunnel ; 300-700 = levels in cm.

In similar cases, the author advises the construction of a silt dyke in such a way as to provide a sufficient outlet for the running water even at the highest floods. This can be done by first making a dyke across the bed of the river further upstream than the barrage reservoir and well fixed into the banks at either end. This dyke should be traversed in the direction of the stream by a vaulted tunnel of which the section is sufficient to allow the water to pass at the time of highest flood. The length of the tunnel must be double the *actual* height of the dyke ; it is necessary to state this, because the dyke continually becomes higher owing to deposits left by each successive flood. The height of the dyke is sufficient to restrain the mass of running water and check its velocity, and as at flood time the stream can find an outlet by the tunnel, it will deposit on the up-stream side of the dyke a mass of detritus that will increase the height of the dyke, while the water which has become somewhat purified, will flow through the tunnel, regain its original bed and pur-

sue a regular course to the barrage reservoir. The entrance to such an upstream, over-flow tunnel consist of a vertical opening with rectangular section (figs. 1-2); the edge of the opening must always be a little higher than the banks of the river. In order to make the matter clearer, let it be assumed that the height of the discharge mouth of the tunnel, the edge of the entrance opening, and that of the dyke are respectively 0 m., 3 m. and 6 m. The height of the river bank after successive deposits may be supposed to have reached 4 m., then we raise the height of the dyke to 6 m., and at the same time, make the tunnel entrance, 1 metre higher, which will put it on the new level of the flood plain (4 m.). The same proceeding will have to be repeated on the occasion of every flood.

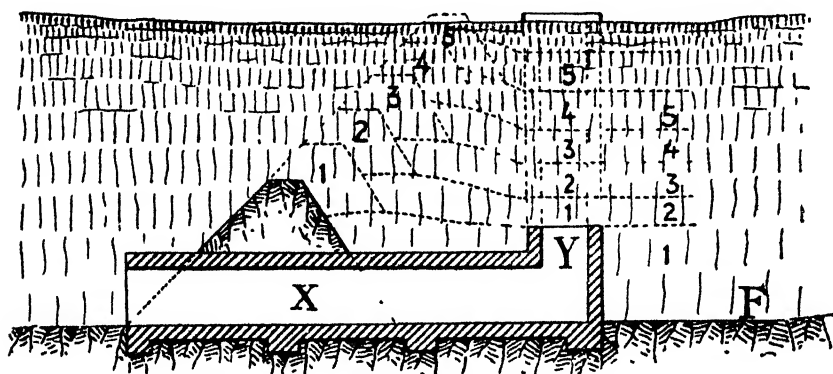


FIG 59 Dyke in section

X = over flow tunnel; Y - discharge pipe; F = river bed.

The dotted lines show the successive heights of the dyke and the over-flow tunnel

It should be noticed that the aperture, instead of rising perpendicularly to the axis of the over-flow tunnel, may be directed obliquely up stream.

It is evident that the expense of this work and of the masonry would add to the cost of the original dyke, and each raising of the dyke would necessitate an additional outlay. The author has, however, originated the idea of making the running water construct nearly the whole of the dyke which he therefore calls a *silt dyke*. Everything depends upon the outlet tunnel having the proper slope and being large enough to cope with the greatest volume of water during the flood period.

In the case of streams of a certain size, several over-flow tunnels can be made; these normally pass through the same transverse silt-dyke. The author is of opinion that by means of such constructions situated further upstream than the barrage reservoir, the water would reach the latter in a relatively filtered condition and there would not be a deposition of detritus sufficient to diminish the volume of the stream to any perceptible extent.

G. D.

gin. It was found that a strong horse in one of the London breweries could raise per minute 33,000 lb. water to the height of one foot which gave a power of 76 kilogrammetres per second. A similar experiment in pumping out a mine gave 74 kilogrammetres per second.

In France, the steam-horse power is estimated at 75 kilogrammetres per second.

The author goes on to speak of PONCE and the nominal horse, which units are being gradually less used, as they lead to confusion and even inaccuracy.

The following figures are the results of numerous experiments made for the purpose of estimating the power of an animal in proportion to its weight.

Animals	Weight	Mode of traction	Force exerted
1 horse	300-450 kg.	in straight line	48-52 kgmm per sec.
1 horse	450-600 kg	" " "	63-71 " "
1 horse	300-450 kg	in circular track (horse gin)	34-46 " " "
1 horse	450-600 kg	" " "	43-50 " " "
1 horse	540 kg	with Fortin's horse gin with inclined plane	54 kgmm. available
1 horse	625 kg.	" "	103 kgmm. available per second
2 Limousin oxen (4 ½ years old)	1380 kg.	agric. work	190 kgmm per second
2 Ambracan oxen 3 years old)	1120 kg.	agric work	128 " " "
2 native Alge- rian oxen	250-300 kg.	agric work	86 " " "

The author points out that there is a reduction in the case of a team of 2, 3, or 4 animals. This reduction varies according to the nature of the team and is due to the lack of simultaneity of effort. When the force of traction is exerted in a circular path, only 27 to 29, or 35 to 39 kilogrammetres per second are available.

G. B.

281 System of Protection of Tractors against Frost.

The Implement and Machinery Review, Vol 48, No 571, p 891.
London, 1922

Serious accidents, such as the cracking of the radiators and the cylinder covers, have been caused by the freezing of the cooling water, with consequent expensive repairs and throwing the machine out of work for some time. Undoubtedly the simplest way to prevent such accidents would be to empty the radiator whenever there is danger of frost; this remedy, however, is dependent on the human factor and forgetfulness may prove costly.

Another expedient is to lower the freezing point of the cooling water

by means of mixing with it glycerine, methylated spirit and chloride of lime.

These remedies also have drawbacks because glycerine soils the tubes of the radiator and the pump, and decreases the power of cooling; methylated spirit evaporates gradually at 80° C, and chloride of lime alone gives good results.

The problem has now been solved mechanically by a French engineer who has invented an apparatus by means of which the radiator is emptied automatically before the water is transformed into ice. A small apparatus formed of a copper worm and a chamber closed below by a valve, communicates with the lowest point of the radiator. When the temperature of the air falls, the water in the worm, owing to its small volume and the high conductivity of the copper, cools more rapidly than that in the radiator, consequently the water in the worm is transformed into ice while that in the radiator is still liquid. The increased volume of the mass of water owing to its transformation into ice, causes a piston to advance which operates the opening of the valve and consequently the emptying of the water from the radiator.

Experiments have shown that the apparatus works when the water in the radiator is still at 3° C. and that all the water can be emptied before transformation into ice occurs

E. P.

282 The Shape of Mould-Boards.

CLARON, CH (Prof at the Agricultural Institute of Algeria). De la forme des versoirs. *Revue Agricole de l'Afrique du Nord*, Year 20, No 173, pp. 746-749 Algiers, 1922.

Geometric considerations led agriculturists and technicians to classify mould-boards as convex, or concave, with a further subdivision into cylindrical, or spiral types, but makers have now been obliged to adopt a more popular method of classification based on a simpler and more self-evident basis viz, the kind of work for which the plough is adapted.

American constructors divide their ploughs into three chief types according to the shape of the mould-board which corresponds to certain definite uses:—

- 1) breaking up stubble;
- 2) straight ploughing;
- 3) breaking up grassland.

The mould-board of the stubble-plough is the shortest but the most curved; it turns over the soil quickly so as to break it up well; it has a characteristic very energetic action. Under similar conditions, it requires the greatest tractive power. When the ground has been cultivated for a long time the strip of soil is made quite soft and the stubble buried to a considerable depth. This type is recommended for farmers and gardeners who grow cereals for several years in succession on the same ground. It is chiefly used for breaking up stubble and its work on new land, or pasture, is often irregular.

Principal characteristics.

Characteristics	Stubble mould-board	Ordinary mould-board	Mould-board for breaking up grassland
Shape	Short	Average length	Long
Pulverising effect . .	Maximum curve	Average curve	Average curve
Traction	Maximum	Average	Minimum
Uses	Maximum	Average	Minimum
	Breaking up stubble	Breaking up stubble and straight ploughing	Breaking up grass- land

The ordinary form of mould-board can be used for nearly all kinds of ploughing, it is rather longer than the preceding type because it is less curved; its pulverising action and draught are both less. Its curvature is not sufficient to allow it to entirely break the clod of earth, and the stubble, instead of being mixed with the soil and buried at different depths, is turned over and merely covered, forming a heavy mass that adheres to the bottom of the furrow where it prevents the water of the sub-soil from rising to the surface-soil.

The ploughs used for breaking up grass-land have a very long mould-board, the clod of soil slips easily and is completely turned over, but is not softened. The draught required for equal work is less than in the case of the other ploughs. These mould boards are used for virgin soil, very closely-growing grass and fields of lucerne. As modern farmers often have occasion to use the different forms of mould-boards, constructors should turn out a type of machine to which, when required, any one of the three kinds can be affixed at will. In this way, the number of ploughs on a farm could be reduced, while at the same time, the right implement for any kind of cultural work would always be at hand.

F. P.

283 Self-Lift Cultivator.

DESSAISIAIX, R., Cultivateur à relevage automatique *Journal d'Agriculture pratique*, Vol 38, No 40, pp 295-296 Paris, 1922

The soil can be worked successfully by cultivators with rigid or spring tines, a method which may often be used instead of the plough. The self-lift cultivator, fitted with multiple tines (Bajac type), has been tried and compares favourably with the ordinary type of cultivators when used with tractors for working over large areas.

Figs. I, II, III illustrate the arrangements for raising and lowering automatically by means of a wire attached to the tractor drawbar, manipulated as required.

In Fig. I, the cultivator is shown in the working position, the sectional frame D is raised being attached to the tractor drawbar A; the wheels C are raised and the depth of working the tines can be regulated accordingly.

At the end of the furrow, the adjustment of the lever B causes the axis to rotate slightly and displaces the bolt which holds the frames D, fixed

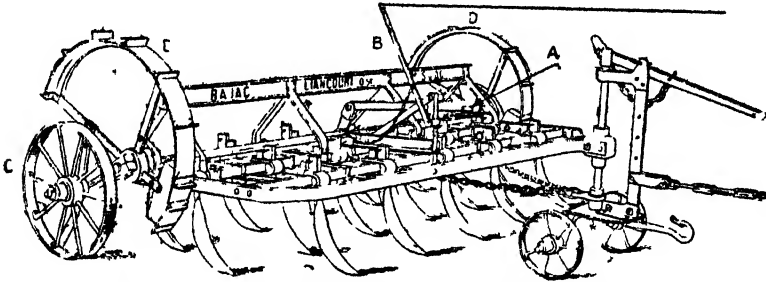


FIG 60. — BAJAC Self lift Cultivator in Working Position

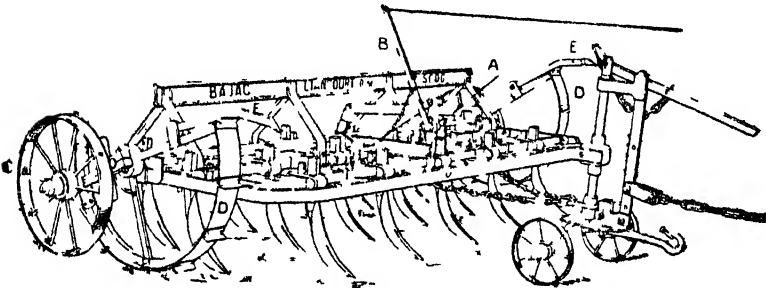


FIG 61 — First stage.

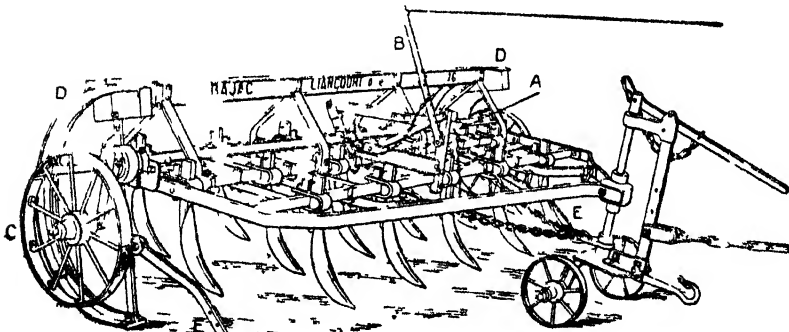


FIG 62 — Second stage.

on the the two rear ends of the cultivator; the frames D thus entail a corresponding down-thrust on the soil, as they are hinged on to the chassis. Consequently with respect to the soil, the rear wheels are maintained in

constant contact with the soil. It may be noted that the raising of the tine brackets is not effected parallel to the soil. When as shown in Fig. III, the brackets are raised to their extreme limit, the two sets of tines are lowered and regulated according to the depth required.

At the end of the furrow the frame falls into gear automatically with the fixture bolts and can only be set in motion by means of the draw bar wire attached to the tine lifting lever B. In this way the tines can be adjusted to the working position.

The cultivator weights 860 to 900 kg. has a width of 3 m. and the three cross bars are fitted with 17 tines, making tracks about 0.18 m. apart; the chassis can, however, be adjusted with the number of working tines required according to the nature of the work. E. P.

284. **Pulveriser with Disk for the Alpe Tractor.**

Deer Model Tractor *Farm Implement News*, Vol 43, No 34, p. 21. Chicago, 1922

A description of a pulveriser with disks, of the tandem type, for a tractor. The special features of the implement are given.

The angle of inclination of each set of disks can be regulated separately by means of two handles placed within easy reach of the driver.

Each compartment is independent in so far that it can follow the unevennesses of the ground without reacting on the chassis, this flexibility is attained by means of an automatic coupling, a universal joint on the control bar, and a pivoting connection.

The coupling arrangement joins the two carriages in such a manner that the back disks cut exactly in the middle of the furrows traced by the front disks. In turning, however, the uncoupling is automatic.

The pivoting connection, which is placed above the fore-carriage, holds the draw-bars, and this arrangement allows each compartment to rise, or fall, without affecting the work of the pulveriser.

The correct alignment necessary for the disks of the hind-carriage to exactly cut the furrows already traced by the front disks is obtained by lever eccentrics, one or other of which can be worked at a time, or both simultaneously. G. B.

285. **The French Disk-Pulveriser for Vineyards versus the American Pulveriser.**

MIR E. Le pulveriseur français à disques dans les vignons et ses avantages, sur le pulvériser américain. *Le Progrès agricole et viticole*, Year 39, No. 51 p 587 Montpellier, 1922

The author, for a long time has been an advocate of the surface cultivation of vineyards as he regards as an unscientific practice, the disturbance by means of deep ploughing, of the roots of a plant such as the vine, which sends out a network of rootlets at a slight depth for the purpose of assimilating the nutritive solutions formed near the surface of the soil.

He is of opinion that the best implement for vineyard cultivation is the disk-pulveriser. The American kinds are both extensible and reversible, as all such pulverisers should be. The reverse action is indispensable, in order that the soil may not always be deposited on the same place. The American type is however, not entirely satisfactory.

The author supplied information and instructions based on his own experience, to a competent implement maker well-versed in ploughing, and the result of their joint efforts is a disk-pulveriser specially adapted to vineyard cultivation, viz., with a strong rigid frame made as short as possible, so as to be easily turned to the end of the furrow.

The implement has been received with the greatest satisfaction by vine-growers and in every way realises the ideal of the designer.

E. P.

286. The Combine-Harvester.

Farm Implement News, Vol. 45, No. 9, pp. 16-17. Chicago, 1922.

The tests were made on 78 farms where the machine was used.

The combine-harvester (reaper and thresher) is best suited for districts where wheat is the chief cereal, and where harvesting is generally done in dry weather.

Since almost the same power is needed for reaping and threshing a light crop as a dense one, this machine is most profitable where the crops are heavy.

The farmers of Kansas have found the combine harvester to be economical; it can be used annually for at least 300 acres of cereals, provided they are not laid.

As the machine is expensive to purchase economy may be effected by using it for threshing other grain, in addition to wheat.

How far it can be employed depends largely on the weather. The net cost of the work is very variable, but the following average figures have been obtained:

Average interest on capital: 1793 dollars at 8 %	\$ 143.44
Depreciation and repairs (20 % of capital)	" 358.60
<i>Cost for working for 11.16 days.</i>	
3 ½ men at 7 dollars per day plus food (1 dollar per day)	" 320.88
Traction: 1 tractor at 15 dollars per day	" 171.90
2 teams of 2 horses for removing the grain at 4 dollars per day	" 91.68
Oil	" 42.42
Lubricating oil	" 5.75
Average cost of working for wheat alone	\$ 134.67
Average area reaped 298 acres	" 301.6
Average cost per acre	" 3.76
Average yield of wheat (bushels)	3070
Cost per bushel	\$ 0.37

Most of the machines cut a width of 12 ft., some, however, cut more or less (14, or 16 ft.). The average area reaped in a day was 26.3 acres.

As all the combine harvesters had only been in use for 2 years, it was impossible to say how long they would last, but 8 ½ years was considered to be the average.

Although some of the machines were drawn by horses, a 15-30 HP tractor seems preferable. The Fordson type of tractor proved too light for this work. If a more powerful tractor is used the machine and the grain-cart can be hauled at the same time.

As regards the employment of the combine harvester for other cereals besides wheat, the following data have been obtained. Some farmers have used it with success for cutting barley and oats. In certain cases, it has been used for threshing sheaves of grain, or the ears, but for this practice to become general, it would be necessary to equip the machine with a grain feeder and apparatus for removing the straw.

Good reports have been obtained from farmers who use the combine harvester for threshing ears of sorghum; on one occasion, 10,000 bushels were threshed by an agriculturist during the first season. G. B

287 Charcoal-Burning Gas-Generators.

PETTRÉ, F. Gazogènes au Charbon de bois *Journal d'Agriculture pratique*, Vol 38, No 37, pp 233-234 Paris, 1922

The author gives the consumption per *horse-hour* of the different types of gas-generators entered for the trials carried out at Neuilly (Seine) during June and July.

Type of Gas Generator	Engine	Power	Consumption per horse hour	
			Charcoal	Water
Société du Gaz Pauvre	Saurer	15 H P	0.88 kg	0.88 litres
Société Lion	Saurer	16 H P	0.89	0.60
Société Cazes	Brauers	20 H P	0.66	0.20
Messrs Thornycroft	Thornycroft	24 H P	0.82	0.40
Société franç de matériel agricole et industriel de Vierzon	Delangère	15 H P	1 kg	—
Id	Semia	20 H P	1 kg.	—

The above figures are for tests made with the generators fully charged, each engine revolving at the rate for which it was constructed.

G B

288 Method of Determining the Quality of Oil.

PARISH, N M When is Oil Good? *Farm Implement News*, Vol. 43, No 18, pp 22-23 Chicago, 1922

The author explains the dilution of the lubricating oil observed when an engine is run on petrol, and describes the consequences which result from deficient lubrication.

The only remedy is to treat this mixture of lubricant and fuel. The petrol must be removed and returned to the engine, and the oil used again for its original purpose. For some years past, an apparatus for the separation of the lubricating oil from the petrol has been affixed to the chassis of both tractors and motor-cars, with satisfactory results. The oil consumption has been greatly reduced and a lighter oil, which is usually cheaper, can be employed.

G. B.

289 Electric Windmills.

PETTRÉ, F. Des Aeris électriques *Journal d'Agriculture pratique*, Vol 35, No 38, pp 258-259 Paris, 1922

Wind-mills, when fitted with suitable transmission, can be made to drive a compound dynamo of special construction, so as to produce a nearly constant voltage with different speeds of rotation and thus provide light for all the buildings on a farm.

With wind-mills of American construction made to produce an electric current, the velocity of the wind must be at least 250 m. per second, as otherwise the dynamos do not furnish sufficient voltage. Therefore storage-batteries of fairly large capacity are necessary, in order to store up the reserve energy produced by strong winds and thus provide the force required for lighting. An automatic relay allows of the storage-batteries being charged under different tensions.

G. B.

290 Experiments with a Multiple Milker.

SAVINI, I. Esperimenti col tiralatte multiplo *Nuovi Annali del Ministero per l'agricoltura*, Year II. No 1, pp 95-102 Rome, 1922

Simple pressure milking machines (Eureka, Alfa, Dalen, Loquies, Sans Rivale), and aspiration milking machines (Thistle, Wallace, Max, Dana, Kennedy, Revalo, Bergner) have been succeeded by new types with combined aspiration and compression movement (SHARPLES and WORTHINGTON), in some instances worked by electricity. A new apparatus, probably of Australian origin, has now made its appearance under the name of the MORETON milker, though this designation is misleading, since the milk flows of its own accord through four small silver tubes introduced into the excretory ducts of the teats.

Description of the apparatus — This apparatus consists of a central rosette giving off from near its upper part four rubber tubes 15 cm. in length to the ends of which are applied four silver pipes in the form of pins, closed at their extremities and provided with four holes in their wall. To each of these pipes is applied a pair of pincers of white metal that can open to a varying extent by means of two ear-like structures, furnished with strong springs which are placed at the end of the pincers, in such a manner, that the silver tube is encircled by the two jaws of the pincers, the object of these jaws is to keep the apparatus applied to the teat of the cow. Connected with the lower portion of the central rosette there is an indiarubber tube interrupted in its course by a glass-tube 5 cm. long which passes

below into another rubber tube. The whole tubing is about 20 cm. in length.

The apparatus is very simple and is composed of few pieces which are chiefly made of rubber. The different metal parts, central rosette, pincers and tubes are easily taken apart for washing and disinfection. The small tubes are made of silver and the other parts of white metal to prevent oxidation, for the apparatus has to be washed frequently, not only with water, but also with disinfectants.

Method of using the milk-drawer. — The silver pins are gently introduced into the teat, the pincers being kept open; these are allowed to close as soon as the tube has entered, in order to prevent the latter falling out and at the same time to serve as a support to the rubber tubing attached to the lower part. When all the four pins are introduced, the apparatus remains suspended from the udder of the cow. The milk flows through the rubber tubes affixed to the pins, passes through the central rosette and entering the attached tube flows into a receptacle beneath. It is not difficult to apply the MORFON milker and when fixed the apparatus is not easily dislodged, even by any hasty movement of the cow. After a time, the milk ceases to flow and theoretically the operation should be complete, the pincers are opened, and the silver tubes are removed from the teats. The apparatus should then be at once washed in water, or better still, in an alkaline solution, then rinsed in pure water and left to dry.

Experiments. — The author has carried out a series of investigations with a view to ascertaining how far this apparatus is practical and economic, as well as satisfactory from the hygienic and physiological stand-points. The experiments which lasted from January 24, 1921, to February 24, 1921, were carried out at the afternoon milking and always in the presence of the author. Two lots of animals, each consisting of two cows, were chosen. Lot I consisted of cows Nos. 1 and 2 both 8 years of age, and lot II of cows 3 and 4 which were 15-16 years old. The experiments were begun by applying the MORFON apparatus to lot I and milking lot II by hand, the procedure alternated every other day, so that the animals milked by hand one day, were milked by the apparatus the next. In the case of both cows of each lot, the duration of the hand-milking was determined and the amount of milk extracted by hand and by the machine respectively. Further, since in the majority of cases, all the milk had not been removed by the apparatus, the rest was stripped by hand, due note being taken of the duration of this second milking and of the amount of milk obtained.

Samples for the estimation of the density and fat content were taken from the machine-extracted milk and the hand-drawn milk.

The milking whether by machine, or by hand, was always performed by the same person, an intelligent man, who soon understood how to affix the apparatus. As soon as one pin was in place the milk poured out, and the milker quickly introduced the other three pins into the remaining teats. The time taken to affix the four tubes varies from 3-4 minutes, according to the dexterity of the man and the nature of the cow.

As soon as the MORETON apparatus is at work, the man supports it with one hand, in order to prevent the milk falling outside the collecting pail as the result of any sudden movement on the part of the cow. With the other hand, the milker manipulates the animal's udder.

At first the milk flow is rapid, and then ceases entirely after a time which is longer or shorter, according to the animal and the day. The milk is collected in an aluminium pail and the quantity is then measured. During the trial month no accidents attributable to the apparatus took place, nor was its use interrupted by the breakage of any of its different parts.

The two following tables give the maximum and minimum amounts of milk obtained and also its composition

TABLE I. — *Amounts of Milk in Litres.*

Evening milking	Minimum				Maximum			
	Lot I		Lot II		Lot I		Lot II	
	Cow 1	Cow 2	Cow 3	Cow 4	Cow 1	Cow 2	Cow 3	Cow 4
With the apparatus	2 61	3 40	3 50	4 33	4 30	4 26	5 80	5 90
By hand	4 00	5 10	3 52	5 00	5 11	6 20	7 40	6 30

TABLE II. — *Specific Gravity and Fat Content of Milk.*

Evening milking	Specific gravity				Fat content			
	Minimum		Maximum		Minimum		Maximum	
	Lot I	Lot II	Lot I	Lot II	Lot I	Lot II	Lot I	Lot II
With the apparatus	1 0300	1 0290	1 0317	1 0312	1 7	1 7	3 5	2 8
By hand	1 0290	1 0282	1 0302	1 0298	3 4	2 7	4 0	3 8

Conclusions — An examination of the experiment tables shows that the multiple milk-drawer can never be a serious rival of hand-milking for many reasons, of which economy is by no means the least important, for the amount of milk drawn by the machine is always less than that obtained by hand, even in the case of the same cow, and in that of the animals tolerating best the use of the apparatus. The difference is very noticeable and may be reckoned as varying on an average around one litre. Further during the experiment the MORETON milker was used by the same person every other day and perhaps if the apparatus had been employed in the morning, as well as in the evening, the decrease might have been even greater. The milk obtained was poorer in fat than hand-drawn milk and the time required for milking was double that required in hand-milking, which is a matter of no little economic importance. As regards the hygienic conditions and the purity of the milk the use of the apparatus is not in

itself a great safe-guard, unless combined with careful management and scrupulous cleanliness ; therefore, if the unsatisfactory state of most of the cow-sheds is taken into account, but little is to be expected from the MORETON milker. In cases of ulceration of the udder, or other infectious diseases where hand-milking is impossible, the new apparatus might prove valuable. The author is inclined to think that the warm welcome accorded by the agriculturists of the district to the MORETON milker was due, to a large extent, to the hope that its use might solve the serious disputes between farmers and agricultural workers, which were at their height when the new invention was put on the market. E. P.

291 Apparatus for the Rapid Determination of Fat and Non-Fatty Substances in Natural and Artificial Butters.

FASSETTI G. (Direttore dell'Istituto sperimentale del Caseificio di Lodi). Apparecchio commerciale per la rapida determinazione del latticello e del grasso nei burri naturali ed artificiali *Nuovi annali del Ministero per l'Agricoltura* Year II, No. 1 pp 91-92, Roma, 1922

The author has studied the construction of commercial butter-testing apparatus intended to take the place of the butyrometers of different types that need great accuracy, the use of delicate instruments, dangerous reagents and a skill in handling often not possessed by workers in small factories.

The GERBER balance which is easily handled and gives results quickly, shows the percentage of water in the butter, but not the fat content. Since butter contains not only water and fat, but a group of non-fatty substances (casein, albumen, lactose, salts, lactic acid etc.) in proportions varying from 0.5 to over 2 %, an instrument was greatly needed by the butter-making industry that would show quickly and with a fair amount of accuracy the fat content on the one hand and the amount of water and non-fats on the other, the approximate proportion of the casein and coagulated albumin being particularly important.

The author's objects in constructing his butyrometer were as follows :

- 1) To obtain an easily handled and quickly cleaned apparatus.
- 2) To avoid the use of delicate reagents and special balances.
- 3) To use a sufficient amount of material with a view to reducing errors in weighing to the minimum.
- 4) To show the observer the amount of albumen present in the butter at the moment he reads off the fat and fat-free contents, instead of only informing him whether the fat content falls below the prescribed limit of 82 %.

Principles of the process. — These are of two kinds : a) physical : heat and centrifugal force ; b) chemical : the use of a substance for liquifying the fat, and of a colouring matter.

Heat is applied for the purpose of melting the fat, so as to permit the particles of water and of non-fatty substances (casein, salts etc.) to move under the impetus of centrifugal force. The liquifying substance renders the fat less viscous and thus reduces the internal friction thereby

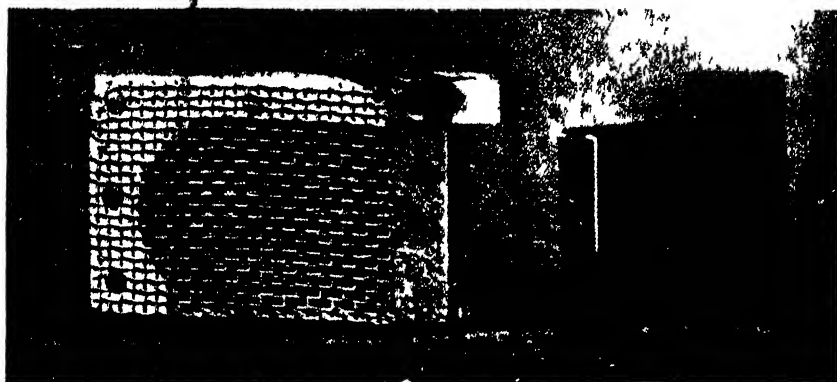


FIG. 6 PALMIRA CAGE

allowing freer movement to the non-fat particles. The colouring substance is used in an infinitesimal quantity to impart to the water and non-fat matters a hue sufficiently different from the natural colour of butter to make the reading of the index an easy matter.

Parts of the apparatus. — This consists of : 1) the butyrometer, which is made of glass and composed of two tubes of different diameters, the lower of which has the smaller diameter and is graduated in cubic centimetres and fifths of cubic centimetres

- 2) A centrifuge able to make 300-400 revolutions per minute.
- 3) A colouring substance composed of a hydro-alcoholic solution of methylene-blue.
- 4) A liquifying solution, such as amyl alcohol.
- 5) A water-bath.

Necessary accessories are : a 5 cc pipette, a 1 cc. pipette, a spatula, or flexible iron blade, a large watch-glass, a flat-bottomed porcelain dish, some rubber corks, and metal stands.

The practical value of the apparatus and the method consists in the large amount of material taken (25 gm) which prevents any small errors due to weighing, even with an ordinary balance, or any other cause, making an appreciable difference to the analytic data.

Method. — After the sample to be examined has been well mixed and made homogeneous, 25 gm. are transferred to a watch-glass or porcelain dish of known weight.

The investigator takes the clean, dry butyrometer in one hand and by means of a perfectly clean spatula introduces the weighed sample into the butyrometer, a small amount being taken up at a time. A little practice makes it possible to reduce the loss of fat, due to adherence to the dish, to less than a decigramme. The apparatus is then transferred to the water-bath raised to a temperature of 80-90° C., so that the fat melts quickly and sinks to the lower part of the butyrometer at the bottom of which the fat-free substances tend to collect. The apparatus is now removed from the water-bath, one drop of the stain and 5 drops of the alcoholic solution are introduced, a dry stopper is pushed firmly into the mouth of the apparatus, the latter is well shaken and replaced in the water-bath. After 5 minutes, the first centrifugation is carried out ; after another 5 minutes the mixture is reheated and centrifuged again. The butyrometer is then put into a stand and as soon as it has reached the temperature of the investigator's hand, the number and fraction of the cubic centimetres occupied by the blue column are read off, note being made that the fractions are fifths. The figure read, when multiplied by 4, gives the percentage of the fat free substances. Thus, if $4\frac{2}{5}$, viz. $4\frac{4}{10}$, are read, we have $4\frac{4}{10} \times 4 = 17.6\%$ fat-free substances, or 82.4 % fat. The colour stratum will be formed of a liquid part and a flocculent part. The latter is composed of the fat-free matter and is chiefly made up of casein and albumin, so that from the amount of flocculent material may be gauged the casein content of the butter or the extent to which it has been purified.

If the quantity of butter to be tested is very large, it is well to take two samples, each from a different part of the mass.

Cleaning the instruments. — As soon as the test is finished, the apparatus is emptied while the contents are still hot and it is then quickly washed with hot water. About one cc. of ammonia is put in followed by more hot water and the inside carefully cleaned with a little brush. The instrument is rinsed once more with hot water and afterwards with cold water and is then placed inverted on the stand and allowed to dry.
E. P.

292. New Apparatus for Apiaries.

I. — ZAPPI RECORDATI, A. Gabietta a passaggio d'ape per introduzione di regine negli alveari *Il Coltivatore*, Year 68, No. 27, pp. 275-281, figs. 4. Casale Monferrato, 1922

II — GALLESIO PIUMA, R. (Museo Internazionale di Apicoltura e Bachicoltura di Torino). La nutrizione delle api coi loro propri favi riempiti meccanicamente di miele o sciroppo Acqui, 1923

The first article gives a description of the cage invented by the beekeeper Giacinto PALPILLA of Bologna and used with complete success by the author.

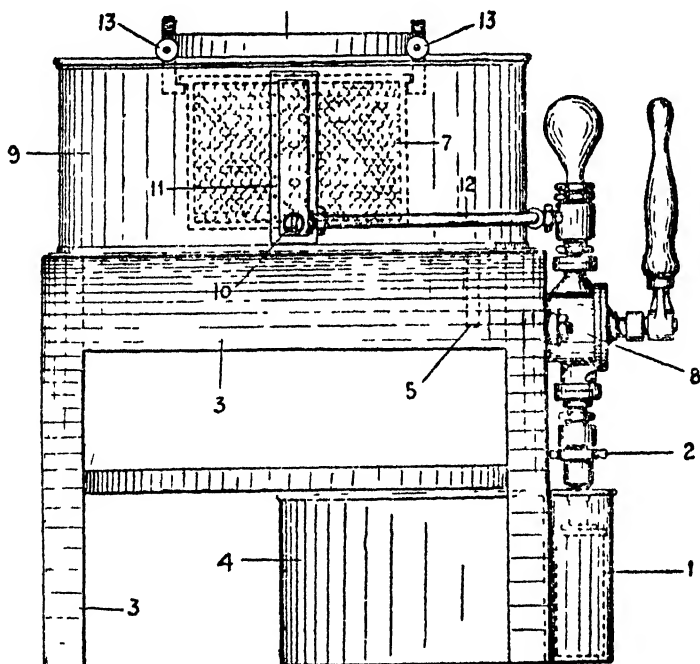


FIG. 64. — The GALLESIO PIUMA Comb-Filler, Type A (Vertical section).

This cage is a small box, $5.5 \times 3.5 \times 1$ cm., made partly of wood and partly of wire-netting; it is closed by a plug of the same width and thickness, and 3 cm. long (see fig. 1). This plug has 2 cavities of a diameter of 9 mm. that run through its entire length. The upper cavity is provided internally with a perforated metal plate to exclude the queen-bees. The upper cavity is half filled and the lower cavity entirely filled with a mixture of honey and sugar. The queen-bee and her escort are shut into the cage, the plug is inserted, and the cage suspended between two supports in the centre of the queenless hive by means of a small revolving plate fixed to one of its larger sides. The bees of the escort, and also those belonging to the hive, attack the sweet-stuff, and after about 24 hours have consumed half the honey and sugar filling the lower cavity, and all of that closing up the upper hole. This allows the workers to go in and out and thus become accustomed to the queen before she emerges from the lower cavity which is opened some 24 hours later. The time (48 hours) is amply sufficient for the queen to acquire the smell of the orphan swarm and since the bees are already accustomed to her, she is sure to be accepted by them, as the author proved in every case. The small size of the cage enables it to be introduced without displacing the combs, or hindering the work of the swarm. It can be removed the first time the hive is visited.

II. — The best method of feeding a hive of bees is to fill their own combs artificially with honey, or syrup, but to do this by hand is a long

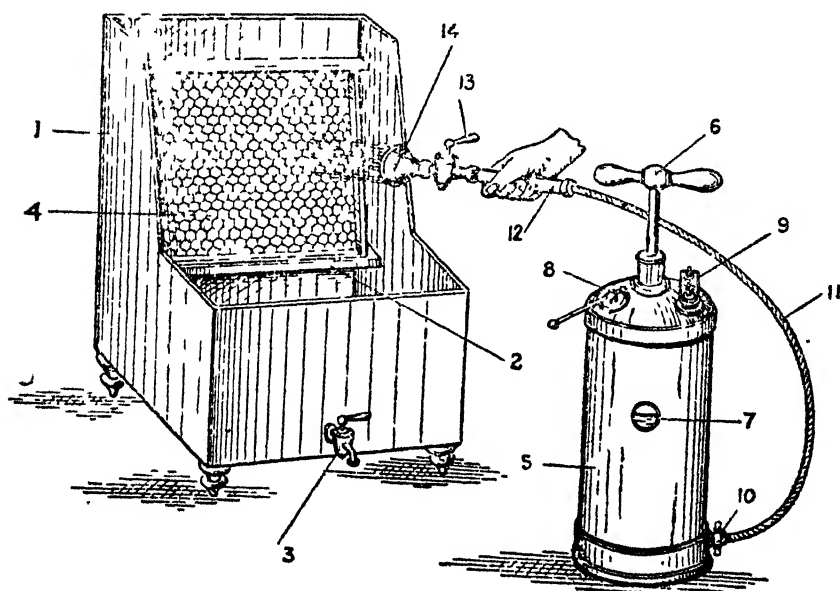


FIG. 65. — The GALLÉSIO-PIUMA Comb-Filler, Type B.

and troublesome task. The author has therefore devised a system which he has patented; this consists of introducing the honey and syrup into the cells by the help of rose-spray. The apparatus constructed by the author is of two types:

A for large and medium-sized apiaries.

B for small apiaries.

Type A (see fig. 2) fills both sides of over 60 combs at the same time in one hour. It consists of a wooden trestle 3), on which rests a box of enamelled iron 9) with a wooden support 6) inside for the comb to be filled. 7). This support is mounted on four brass wheels and can run from one end of the box to the other. On the sides of the box are fixed two roses 11) communicating by means of two brass tubes with a pump that draws up the honey and syrup from a vessel 4) by means of a special wire filter 1). A tube 5) attached to the bottom of the vessel carries off and returns to the pump any excess liquid thrown upon the combs by the roses.

Type B (see fig. 3). Fills about 20 combs per hour, filling the two faces alternately. The apparatus consists of a box of enamelled iron 1) provided with a discharge-cock 3) and containing a support that holds the comb 4), in a horizontal position. There is also a pressure reservoir 5) with hand-pump 6), safety valve 9), screw-stopper 5), and glass peep-hole 7). From the reserve passes a rubber-tube 11) attached to a rose 14) provided with a tap and handle 12).

F. D

BIBLIOGRAPHICAL NOTE

293. BOND, J. R., M. Sc., N. D. A., M. B. E. (Member of the Advisory Committee of the Ministry of Agriculture and Fisheries, Great Britain). Published by Benn Bros. Ltd. London, 1923.

This work is intended for the use of practical farmers and students of agriculture and deals in a thorough manner with the functions and the construction of the various implements and machinery which are essential to modern farming. The numerous and clear illustrations and descriptions should enable the farmer to select and adjust his machines. The author makes a special study of tractor tillage. The subject requires the careful attention both of farmers at home and also in the Dominions and Colonies, as much loss and dissatisfaction which has been experienced in the past may be traced to the purchase of unsuitable tractors or implements.

W. S. G.

AGRICULTURAL INDUSTRIES

*Plant Products.***294. Experiments as to the Effect of Temperature in the Fermentation of Sparkling Wines.**

MAZZEI, A. Contributo sperimentale allo studio dell'influenza della temperatura nella fermentazione dei vini spumanti in *Le Stazioni sperimentali agrarie italiane*, Vol. LV, Pts 7, 8, 9, pp. 292-502. Modena, 1922.

As a result of experiments made by the author at the "R. Stazione Enologica Sperimentale" at Asti (Italy), chiefly with the idea of ascertaining, from the technical standpoint, the suitability of the two forms of ferment, the following points are worthy of notice:— 1) at high temperatures (20-26° C) it is encouraged and is more rapid but is incomplete; 2) a medium temperature (15-20° C) gives more satisfactory results than a high or low temperature; 3) the carbon dioxide pressure exercises a restraining effect on the process of fermentation; 4) of the two forms of ferment studied, the KAYSER ferment works more satisfactorily under warm conditions and the PINOT ferment the more when exposed to light; 5) the most suitable temperature for fermentation of sparkling wine varies from 13-16° C.

F. D.

295. The Industrial Utilisation of Vegetable Oils.

VISRECQ, A. Utilisation industrielle des huiles vegetales *Revue Agricole de l'Afrique du Nord*, Year 20, No 171, pp 720-723 Algiers, 1922.

The author is of opinion that Algeria could render herself to a certain extent independent as regards motor power, by using native vegetable oils as fuel for semi-Diesel engines.

The oils obtained from the palm, peat-nut, cotton and sesame have been proved by analysis to possess the necessary physical and chemical qualities. Their average calorific power is 9366 calories per kg., the lowest met with being 9325 calories. The consumption registered during the experiments was 278 gm. of cotton oil per horse-hour which corresponds to $0.278 \times 9325 = 2592$ calories, or a thermic efficiency of 0.245; which is not very low, as many 4-stroke high-pressure engines develop one horse-hour with 2200 calories, or a thermic efficiency of 0.290.

It would be interesting to carry out similar experiments with castor-oil, which closely resembles palm-oil in the time necessary (at about 50° C) to reduce it to a normal condition of viscosity. The Semi-Diesel engine is not an explosion, or a combustion, engine. The fuel is introduced after the air has been previously warmed, as in the case of the Diesel engine, but its compression is less, and its temperature is too low to cause combustion. The kindling must be effected by means of a special arrangement. In the Diesel engine, the initial compressure amounts to 30-35 kg. and remains almost constant during the combustion; in the semi-Diesel, the compression never exceeds 10 kg., but the pressure reaches 20-25 kg. at the end of the

combustion. In order that this engine may work satisfactorily, the following modifications are necessary:—

a) The introduction of an air-pump barrel, or a piston, in tandem with the engine-piston to suck in and compress the air. With the shield acting as a pump, the air supply is insufficient to obtain complete combustion, which needs at least 25 gm. of air per gm. of oil.

b) The present compression of 10-12 kg. must be increased to 20 kg. or more in order to improve the thermic efficiency.

c) The volumetric return should be increased by substituting valves for the covers with automatic hinges.

d) The pieces of the steam-generator ought to be easily taken apart, and the fuel-pump must be easily regulated on account of the variable characters of the oils

For engines working at 200 and 400 revolutions, it is possible to use oils that apparently resist combustion, provided the pump and sprayer are of the right kind.

The advantages possessed by the Semi-Diesel are undoubtedly: absence of strong emplacement, reduced weight of parts, smaller space occupied, possibility of driving directly, or by means of a belt, the simplicity of its construction (no valves, or compressing air pump), high yield, reduced consumption.

It has all the requisites of a tractor engine, in which capacity it has already given good results; when mounted on a 70 HP tractor running at 210 revolutions, the Semi-Diesel consumed 215 gm. of petrol, as against 240 gm. of palm-oil per effective horse-hour.

E. P.

296. **The Utilisation of Lime Seed Meal as Manure and Stock Feed and the Oil Value.**

Bulletin of the Imperial Institute, Vol XX, No. 4, pp 465-468 London 1922.

Apart from the use of lime seeds for planting and as litter in cattle-pens, insufficient attention has hitherto been given to the utilisation of this waste material. Investigations have recently been made by A. E. COLLENS, Government Chemist and Superintendent of Agriculture, Leeward Islands to ascertain the oil value and the composition of the residual meal.

Analysis indicates that the lime-seed oil is generally similar in chemical properties to cotton seed oil, but for industrial purposes it appears that the oil is unsuitable for refining; the crude oil, however, is adapted to soap manufacture.

From the agricultural stand point, the residual meal has evidently a high manurial value, and compares favourably with rape-seed cake, cotton seed cake, etc. The oil pressed residue and the crushed seed, contained respectively:— nitrogen % 4.9 and 3.43, potash % 0.685 and 0.48, phosphoric anhydride % 1.05 and 0.74.

The meal, although it contains less carbohydrates than undecorti-

cated cotton-seed meal, is richer in crude protein. The following comparison is made :

	Oil-pressed residues %	Crushed seed %	Uncorticated cotton seed meal %
Moisture.	15.08	10.54	11.32
Crude proteins	30.50	21.37	23.75
Containing true proteins.	20.70	14.50	—
Fat	14.20	39.87	6.16
Carbohydrates	17.00	11.90	31.33
Crude fibre	20.05	14.10	21.80
Ash	3.17	2.22	5.64

A. F. COLLENS states that the raw and crushed lime-fruit pulp is eaten with avidity by cattle and pigs and both appear to thrive well on these products. The milk obtained from cows fed thus in Dominica is usually very rich and well above the standard, viz. 30 % fat, and 8.5 % solids not fat. In the case of livestock unaccustomed to feeding on lime products, the slightly bitter meal could be made attractive and palatable by admixture with molasses. M. L. Y.

297. Ensilage Experiments made in Germany.

VAN WENCKSTERN, H. Erfahrungen mit Silofutter verschiedener Herstellung *Deutsche landwirtschaftliche Presse*, Year 49, No 14, p 104. Berlin, 1922

Under the direction of the "Ökonomische Gesellschaft" at Dresden, feeding experiments have been in progress in Saxony to test the value of forage silaged in various ways. The following results have been obtained.

1) The conservation of forage by means of the electric current system (1), at present the most satisfactory method. This causes the minimum loss of dry matter and of albuminoid substance. It is especially suitable for green juicy forage, rich in albuminoids, as well as for plants otherwise not silaged easily owing to the excess of sap or moisture.

It is not, however, suitable for plants with a low moisture content. In this case and when the season is dry, and on small farms, the electric system costs more than the usual method of ensilage.

2) The improved compression system (the silo is filled by means of a suction-tube with chopped forage plants, which are spread and placed under heavy pressure; the temperature then rises to 45° C) provides forage which can be placed second on the list. This method is not advisable for fresh, juicy forage, or that which is soaked with rain. Under favourable conditions the electrical system is preferable.

3) The manual labour and compression method (filling the silo by manual labour with dried but not chopped material) is both difficult and inconvenient on small farms and with limited capital, where the silo is installed and worked by the owner and his family. On large farms it is only practicable where the farm hands are used to this work.

(1) See R. 1922. No 776. (Ed)

4) The turret silo (filled with material which may, or may not have been dried and chopped, and then trodden under foot) ; this gives an acid silage, compared with that produced by the two preceding methods which give a sweet silage, and is therefore advisable for very moist material, which should not be subjected to the electrical process. As this method is undoubtedly easily worked, it is preferred on large farms to the sweet silage, that is to say, a fermentation mainly acid is preferred to one that is mainly alcoholic, although the latter is of more durable quality.

5) The inoculation method, with pure bacteriological cultures, is worth further study. F. D.

298. The Preservation of Green Forage by means of an Electric Current.

2nd Communication de l'Administration Centrale des Etablissements fédéraux d'essais et d'analyses agricoles de Liebefeld près Berne, pp. 1-3, 1922.

The Central Administration of Liebefeld has forwarded further information to supplement the previous communication which appeared under the above head in No. 776, 1922 of the International Review of the Science and Practice of Agriculture (see Tables pp 497-499).

In the report from Custerhof where electrically prepared silage was also fed to the cattle, the following summary is given of the results of the qualitative analysis of the milk " The milk of cows fed on electrically prepared forage is suitable for immediate consumption, but cannot be used for making cheese, especially Emmental cheese.

The preservation of forage by means of an electric current is a process which, under its present form, cannot be recommended to the Swiss agriculturist. G. B.

299 Experiments in Canning and Storing of Sweet Potatoes in the United States.

I — MAGOON, C. A. and CULPEPPER, C. W (Office of Horticultural and Pomological Investigations) Study of Sweet Potato Varieties with Special Reference to their Canning Quality, *U. S. Department of Agriculture, Bureau of Plant Industry, Bulletin No. 1041*, pp 34, plates 3, bibliography, Washington, 1922.

II GEISE F. W. Storing and Bedding of Sweet Potato Stock, *Virginia Truck Experiment Station, Bulletin Nos. 39 and 40*, pp. 223-234, figs 8. Norfolk, Virginia, 1922

I — The article gives a description of comparative tests of the canning qualities of different varieties and strains of sweet potatoes grown at the Arlington Experimental Farm (Virginia). The potatoes were handled under carefully controlled conditions, and the uniform treatment which they received permits a direct comparison to be made.

The differences in acidity among the varieties tested were negligible, but the relative proportions of cane sugar and dextrose content were shown to vary greatly (total sugars from 2.6 %).

TABLE I. — Comparison between the nutritive substances contained in the electric silage made at Liebefeld and elsewhere.

Constructor of the plant and holder of the patent for the process of preserving forage by means of an electric current	Nature of current	Place of experiment	Character of forage	Results of analyses of electric forage made by the Federal Berne-Liebfeld Institute of Agricultural Chemistry							Length of time
				Length of time							
				% Protein	% Fat	% N-free extracts	% Fibre	% Ash	% Water		
Elektrofutter Gesellschaft m. b. H. Dresden A (Germany)	continuous current of 220 volts	Lauschen mühle near Thiengen, Wald district (Germany)	mixture of vetches and peas	3.2	0.6	2.6	5.0	2.6	86.0	13 weeks	
Agricultural College Gusterhof, St. Gallé (Switzerland) Plant installed by the College itself	alternate current 250-500 volts	Agricultural College of Gusterhof St. Gallé (Switzerland)	grass, clover lucerne	5.2	0.8	11.2	7.3	3.7	71.8	10 weeks	
S. A. Workshops, Oerlikon-Zürich Switzerland	alternate three-phase current 500 volts	Liebfeld - Berne (Switzerland) Research Institute. Layer 1 of electrically prepared forage	Artificial 1921 meadow with predominance of violet clover	3.2	0.1	4.1	4.1	2.8	85.4	14 weeks	

TABLE II. — *The acid content of forage electrically siloed at Liebefeld compared with the acid of forage preserved elsewhere.*

Place of experiment	Interval between the last forage put into the silo and the first sample taken	Description of layer	Nature of forage	Parts per 100 of the original substance of the electrically prepared silage		Analysis made by
				Total acid calculated as lactic acid	Volatile acid calculated as acetic acid	
Agricultural College of Custerhof St Galle (Switzerland).	10 weeks	First layer	Lucerne with little grass	1.57	0.27	Dr K Meyer Custerhof St Galle
		Layer above the centre of heap of forage silage	Grass with clover	0.73	0.27	
		Layer below the centre of heap of forage silage	Grass with clover	0.73	0.07	
		Layer at bottom of heap of forage silage	Grass	0.89	0.22	
Liebefeld-Berne Experiment Institute (Switzerland)	12 weeks	Es 5 first layer	Old artificial meadow grass	0.90	0.38	Federal Institute of Agricultural Chemistry Liebefeld - Berne
		Es 4	Mixed oats vetches and rape	0.67	0.52	
		Es 3	Artificial, 1921, meadow, clover and Gramineae in the proportions usual in Switzerland	0.43	0.34	
		Es 2	Artificial 1921 meadow, clover and, dandelion	0.49	0.34	
		Es 1	Artificial 1921 meadow, mixed clover and Gramineae	0.36	0.22	

* Es. = electrically prepared silage

From *Untersuchung der Futtermittel* third Ed Kovac.

During the experimental period, properly so-called, the feeding of the different layers was carried out as follows

Layer Es 5 for 3 days Layer Es 3 for 9 days Layer Es 4 for 4 days Layer Es. 2 for 4 days

TABLE III. — *The butyric bacillus content of electrically prepared forage and of the solid excrement voided by the dairy cows during the time they were fed on this forage.*

Place of experiment	No. of forage samples	No. of butyric bacilli present		No. of samples of excrement
		In the pasteurised products per gramme of deeply seated layer of electrically prepared silage	In the pasteurised products in a deeply seated layer per gramme of excrement voided during feeding on electrically prepared silage.	
Lauschemühle, near Thilengen, district of Waldshut (Germany)	1	100-100 000	not determined	none
Agricultural College, Custerhof, St. Gallé (Switzerland).	2	100-10 000	not determined	none
Estate of Bocken near Horgen (Switzerland) plant made at the S. A. Workshops, Oerlikon-Zürich alternate current 230 volts	1	1 000 000	100 000-1 400 000	5
Research Institute Liebefeld Berne (Switzerland) . .	5	100-1 000	5 000-500 000	50

Observations were made as to the best methods of handling the sweet potatoes before canning; the cause of discoloration and blackening when exposed to air and the means of avoiding this consequence; the suitable temperatures and time periods for canning, and the effect on appearance and flavour.

From the results of these investigations which cover a period of 3 years, the following points are emphasised;

- 1) Steam for a sufficient length of time to make peeling rapid and easy, and to cook the potato;
- 2) Handle so as to expose the cooked material to the air for as short a time as possible.
- 3) Pack the cans as full as possible in order to exclude oxygen and prevent discoloration.
- 4) Fill the cans with hot material not below 70° C in order to exclude oxygen.
- 5) Avoid bringing the material into contact with iron or iron compounds which intensify discoloration.
- 6) Shorten the process as much as possible to insure safe preservation.

A descriptive list is given of the varieties tested. As regards canning quality the «Gold Skin» takes the first place. Of the other varieties, Yellow Jersey, Early Red Carolina and Big Stem Jersey proved the best of the dry firm types, Dooley, Porto Rico, Nancy Hall, Mullihan, and Vineless Pumpkin, of the deep coloured, moist varieties; Belmont, Miles, and Yellow Strasburg were the best of the lighter fleshed medium moist types.

The plates show the shades of colour of different varieties when canned in the form of pie stock

II. — *Storing and bedding stock.* The author gives a summary of the essentials in a successful sweet potato storage house and the selection and storage requirements for good seed stock and preparation of seed bed for stocks and bedding.

A description is given of a combined sweet potato and Irish potato storage house of one thousand barrel capacity at Tasley (Virginia), the results obtained during the season 1921-22, and the moisture and temperature control. Investigations have shown that when a relative humidity of 60-70 % is maintained with a temperature of 55° F the best storage results have been obtained. The accompanying graphs show that relative humidity may be controlled within certain limits in a storage house, independent of external conditions.

M. L. Y.

Dairying.

300. **The Association for the Sanitary Control of Milk in Seine-et-Oise (France).**

Journal d'Agriculture Pratique, Year 86, Vol. II, No. 51, pp. 515-516. Paris, 1922.

This Association tests the milk intended for public consumption. The control exercised is optional; any agriculturist wishing to avail himself

of the services of the Association sends in a request, on receipt of which the Commission pays a visit to his farm, and if it is found to be well-organised and equipped, and also in a satisfactory condition from the stand-points of cleanliness and hygiene, the owner's application is accepted.

In order to obtain sanitary control and the advantages accruing from it, dairy-farmers must give a written assurance testifying to their willingness to comply with certain conditions of which the following are the chief. —

No tuberculous cow must be retained on the farm. All the dairy cows, and any cattle that might contaminate them, must be subjected, at least once a year, to the tuberculin test. Any animals in which the reaction has been distinctly positive must be removed without delay. The doubtful cases are to be isolated and re-examined.

No new cow may be introduced into the cow-shed till it has been pronounced by the veterinary to be perfectly healthy in every respect.

The veterinary must also examine all the dairy cows at least once in three months. Any animal showing suspicious symptoms is to be isolated and subjected to a further test.

Persons suffering from a disease that can be transmitted by means of milk shall not be employed on the dairy farm.

The farmers shall not sell, without a guarantee from the Departmental Agricultural Office, any milk that has not been produced under the above-mentioned conditions.

The farm shall be subjected to the milk control of the Departmental Service and organised by the Stock-Breeding Committee of Seine-et-Oise.

Farmers that have been accepted by the Control Commission and the Departmental Agricultural Office, on the above-stated conditions, are authorised to sell their milk labelled "Whole milk" (*Lait intégral*) which vouches that the product is clean and wholesome and comes from a farm under the control of the Departmental Agricultural Office of Seine-et-Oise.

The working expenses of the control service are defrayed by the Departmental Agricultural Office and the dairy-farmers interested.

Further information respecting this control scheme can be obtained from M. André Leroy, *Secrétaire technique du Comité départemental d'élevage de Seine-et-Oise*, the Institut agronomique, 16 Rue Claude Bernard, Paris.

F. S.

301. The Preservation of the Purity of Milk.

DE MONTCAULT, P (Membre de l'Académie d'Agriculture). Un nouvel aspect de la question du lait. *Journal d'Agriculture pratique*, Year 86, Vol II, No 43, pp 349-350 Paris, 1922.

The handling to which milk is now subjected exposes it to frequent contact with the air, and to risks of contamination. In order to keep the milk pure, some farmers sell it in bottles, but this is very expensive; the author therefore suggests another method which has all the hygienic advantages of bottling and costs less. Any such process must be based

on the following principles: 1) the substitution of asepsis for pasteurisation or sterilisation. Bacteria develop more rapidly after a certain lapse of time, in pasteurised, than in untreated, milk. Chilled milk, on the other hand, resists bacterial contamination for a longer time; 2) a uniform sale price must be fixed for the whole year. If the milk were sold under a special mark, the public might be induced to pay the same price in summer as in winter.

In order to prevent the milk coming into contact with the air the author suggests that it be poured, immediately after it is drawn from the cow, into tins in which the cover is replaced by a valve. This arrangement would enable the milk to be cut off from all contact with the outer air, on entering the tin. The milk would be taken to the consumer in the same tin.

The author suggests that the apparatus used to supply motor spirit in the street could be adapted to prevent milk being poured into various receptacles and thus running the risk of contamination during its distribution to the customers.

In consideration of the purity of the milk, the public would be willing to pay the extra expense involved, while the increased receipts would compensate the producer for being unable to skim any of his milk. F. S.

302 *Oidium rubrum*.

PROKS, J. *Le Lait*, Year 2, No 9, pp 716-719. Lyons, 1922

This mould forms arborescent filaments, some of the cells of which are enclosed in a stronger membrane than others, and produce spores 84-168 μ long and 70-126 μ broad. These cells are difficult to separate. The fungus is placed in the genus *Oidium* on account of the method of its spore formation. The cells of the filaments take on a slight reddish tinge and the presence of some red substance in the cell contents imparts a similar colouring to the colonies. The author has given this mould the name of *Oidium rubrum* because of the brilliant red hue distinguishing the cultures during the first few days of their growth. In the article he describes the results obtained by growing the mould on the following cultural media: whey-gelatine; whey-agar; milk; whey; cream cheese; lactalbumin; bread, potatoes; rice paste; potato paste and USCHINSKI'S solution.

Oidium rubrum has the power of secreting a proteolytic ferment that peptonises the albuminoids of milk without the previous coagulation of the latter. It is a very rare species and forms few spores which can only be separated with great difficulty. F. S.

303. **Effect of Removing the Butter-Milk upon the Rancidity of Butter.**

IBSEN, CHR. H. *Ostesurt Smør* (Den staaerke Skylnings indflydelse paa Smerrets kemiske Sammensaetning og Kvalitet, 106 *Beretning fra Forsøgslaboratoriet*. Copenhagen, 1921.

From the results of the experiments made by ORLA JENSEN, and of those conducted in the experiment laboratories, the following conclusions have been reached.

Butter with fat granules 2-8 mm. in diameter after it has been thoroughly freed from butter milk, contains 22% less casein and 37% less lactose than butter that has not been similarly washed. Butter made from much fermented cream and moderately washed contains less casein than butter that has been but little washed. Thus, during the autumn it is advisable to let the cream ferment well, in order to prevent the butter turning rancid.

Given a moderate amount of washing, autumn butter composed of large granules will be inferior in quality to butter with granules 2-3 mm. in diameter.

If during the hot months, butter is churned in such a manner that it can be well washed, its quality will be better after this treatment than that of butter from which the butter milk has been less thoroughly removed. Therefore, in the warm season, and especially in August and September, the acidity of butter and the consequences to which it gives rise, can be prevented effectually by the simple means of thorough washing.

(Corr. Denmark)

304. Variations in the Microbic Content of Butter in Cold Storage.

DALLA TORRE, G *Annali dell'Istituto sperimentale di Caseificio in Lodi*, Vol I, No 5-6, pp 169-198 Lodi, 1922

The author has investigated the behaviour of microbes in butter kept in cold storage, in the Laboratory of Bacteriology at the Experimental Cheesemaking Institute of Lodi. With this object, various samples were kept in an icehouse and in a refrigerator (at about 0° C) and studied bacteriologically in the various stages of their transformations; comparing, at different periods of conservation, the germ content of the surface with that of the interior of the butter. The results obtained indicate that:—

Butter preserved in an icehouse soon undergoes considerable alterations in its organoleptic characters; as early as the 7th day rancidity begins to develop on the outside; the butter turns yellow, the smell and taste commence to become sharp, etc.; rancidity has reached an advanced stage by the 31st day. In a refrigerator these changes follow after a fairly long time and only in a very thin surface layer.

Butter kept in a refrigerator contains a very large number of bacteria, that is to say as many as 14 millions per gramme. If the bacteria are represented by cheese species (milk bacteria) their number does not affect the good quality of the product; this is not so when they consist of eumycetes, schizomycetes, etc. and lipoclastic organisms which, consuming a part of the fats, cause defects in the butter. This flora, unfavourable to good preservation, occurs especially in products kept for a long time in unsuitable surroundings, chiefly owing to temperature, or not being properly made, or having been washed with water containing a detrimental microbic flora.

Butter should be refrigerated as soon as it is made, or at least taken at once to the collecting centre for despatch to the refrigerator.

Butter kept for a short time in an icehouse has a rather low bac-

terial content, formed principally, at the outset, by milk bacteria. Consequently, there is a rapid increase in the germs, which in the interior reach the maximum on the 14th day and still sooner on the exterior, after which there is a gradual decrease. On the outside the bacteria causing rancidity become increasingly active, while inside they generally disappear at an early stage.

In the refrigerator the germs live very much longer than in an ice-house; this confirms the work of former writers. Both in an icehouse and in a refrigerator the milk bacteria, torulae, saccaromycetes and *Oidium lactis* live longest; for butter in a refrigerator *Mycoderma* which, in the last stages of preservation, is present in large numbers, also lives long.

F. D.

BIBLIOGRAPHICAL NOTES

305. BURATTI, M Sulla biochimica della fermentazione alcoolica (Biochemistry of Alcohol fermentation) *Rivista di Ampelografia*, Year III, No 11, pp. 161-171 Alba, 1922

From the investigations undertaken by the author at the "Laboratorio di Chimica tecnologica agraria" at R Istituto Superiore Agrario di Perugia it has been deduced that "the products of alcohol fermentation from grape must such as ethyl alcohol, carbon dioxide, glycerine, succinic acid, higher alcohols, etc demand the addition of aromatic alcohol, of tirosol and triptofol, the last represents the first nitrogenous form of alcohol found in wine

F. D.

- 306 HASTINGS, E G, DAVENPORT, A and WRIGHT, W H (Department of Agricultural Bacteriology University of Wisconsin) The Influence of Certain Factors on the Methylene Blue Reduction Test for Determining the Number of Bacteria in Milk *Journal of Dairy Science*. Vol V, No 5, pp. 435. Baltimore, 1922

Discussion as to the importance of the bacterial content of milk in determining its quality. The value of the methylene blue reduction test (1); the controlling factors are indicated and directions for application of the test are given.

F. D.

307. HUCKER, G J. (New York Agricultural Experiment Station, Geneva, N Y). La flore du fromage américain de Cheddar The Bacterial Flora of American Cheddar Cheese. *Le Lait*, Year 2, No, 9, pp 701-708, 1 table. Lyon, 1922.

A short review of the studies made on the subject of the flora of American Cheddar cheese

F. S.

(1) See R. 1921. No 1281 (Ed)

PLANT DISEASES

Diseases, parasitic, non-parasitic or of unknown origin.

308 Review of the Literature Dealing with "Stipplestreak" and other kindred diseases of the Potato.

ATANASOFF, D. A. A Study of the Literature on "Stipplestreak" and Related Diseases of Potato *Mededeelingen van de Landbouwhoogeschool en van de daaraan verbonden Institute* Vol 26, Part 1, pp 1-52 Wageningen, 1922

These bibliographical investigations on the diseases of the potato were undertaken with the object of discovering whether the disease known under the name of "streak", or "stipplestreak", was a new malady

As a result of his studies, the author reached the conclusion that though stipplestreak has been regarded as a disease of recent origin, it is on the contrary one of the oldest, if not quite the oldest, of the diseases attacking the potato. Further, it is clear that all the modern ideas of a relationship existing between "leaf-roll", "mosaic", and the maladies formerly called 'curl', Krauselkrankheit" and "frisolée" are wholly without foundation, while less time would have been expended on the study of the nature of the affection known as "degeneration", or "running out", if the older literature on the subject had received more careful attention

In the present review the author has made a concise summary of all that has been published regarding this group of diseases from 1775, the year when this form of degeneration, which still attacks the potato plant in Britain and on the Continent of Europe, first began to attract notice. The review mentions some 140 works, and is divided into two periods, one dating from 1775 to 1900, and the other, from 1901 to 1922; the first period being treated more exhaustively, as it contains less well-known, or forgotten, publications of special interest

G B T

309 The Birch-Tree Disease known as "Wisa" in Finland.

HINTIKKA, T J Die "Wisa" Krankheit der Birken in Finnland, *Zeitschrift für Pflanzenkrankheiten und Gallenkunde*, Vol XXXII Parts 5 6, pp 193 210 Stuttgart, 1922

In some districts of Finland, trees of the common birch (*Betula alba*) are frequently met with that are known by the name of "Wisabirches" (in Finnish, "*wisa hoida*") because they are affected by a disease called "Wisa"

These trees produce the wood that passes in Finland under the name of "Wisa-wood" and is also known in commerce as "Lily-wood", or Finnish or Swedish, veined birch. It is used largely for cabinet and furniture-making.

Descriptions of these diseased trees and their wood are to be found in the literature dealing with forest-botany, technology and phytopath-

[308-309]

logy ever since the XVIII century, but the causes of the disease are still far from being clear. Some authors attribute the veining of the wood of birch trees affected with "Wisa" to bud formation, and this view, which was distinctly expressed by GÖPPERT in 1579, has been repeated in almost all treatises, especially forestry treatises, until the present day. It is, however, quite erroneous like all other theories of the etiology of "Wisa wood" including that held by SADEBECK (1888) who believed the affection to be due to parasitic fungi.

The author undertook a thorough study of the causes of this disease which occurs in other countries of Northern Europe, and profited by the copious supply of material at his disposal in the various districts of Finland. He draws attention in the first place to the fact that not all trees are attacked the same season, but only those showing a certain susceptibility, and that these are affected to a varying extent.

The habit of the diseased birch is altered in different ways according to the severity of the attack. Sometimes birches suffering from "Wisa" appear almost normal, their trunk growing high and straight, at other times, however, the trunk becomes irregularly branched and is oblique, or curved. In every case nodosities or tumours, or at least an abnormal laceration of the cortex accompanied by characteristic brown streaks are seen. The nodosities do not form at the point of branching, but either above or below it; externally there is no sign of bud formation. The dark bands characteristic of the disease vary greatly in number and size in different individuals, and even in the same trunk, so that there are different types of veining (coarse or fine) according to the position of the veins being on the outside or inside of the wood; the various veinings have different values commercially. From the examination of a trunk from which all the bark has been removed, it is clearly seen that there is no sign of bud formation.

The chief morphological changes characterising the disease are a greater development of the medullary rays and an increased formation of sclerotic cells in the cortex, showing that the veining is due to anomalies in growth. The widening of the medullary rays is most probably caused by a more copious flow and consequent larger accumulation of nutritive substances in some parts of the body of the tree, this increased supply being perhaps also influenced by meteorological factors. The abundant formation of sclerotic cells is no doubt due to these causes, although the chief factor is an interference in the circulation of the carbohydrates.

As the disease progresses and the typical veining is produced, spaces and passages of schizogenetic origin and of various sizes make their appearance in the cortex and in the wood, being often visible even macroscopically. The surrounding cells contain a large amount of tannin and gummy substances, while the plasma turns brown, but neither in the cells themselves nor in the schizogenetic spaces, is there any sign of parasites.

In conclusion, it may safely be stated that this disease is not of parasitic origin, but is due to external causes, such as special conditions of

climate or soil. It is a disease of the "gummosis" type, although the gum-exuding stage is not reached, and the disease remains in a latent state for the cell-walls and cell-contents are never dissolved. "Wisa" must therefore be classed among the group of enzymatic diseases.

G. B. T.

Plant parasites.

310. Breeding of Disease Resistant Varieties of the Rice Plant.

SUYEMATSU NAOJI Ine Taibyôsei Hinshu Ikusei ni tsukite *Daimppon*, *Nôkwaishô* (Journal Agricultural Soc, Japan), No 493, Vol XI, pp 8-13, 1922 (Japanese)

Annual loss of rice grain production due to the prevalence of parasitic diseases such as "Imochi" (caused by *Dactylaria Oryzae*), "Goma-hagare" (caused by *Helminthosporium Oryzae*) and "Shiro-hagare" (a bacterial disease not yet well worked out) is estimated to amount over 20 000 000 yen which is maintained by the author to be reduced greatly by means of cultivating disease resistant varieties. It has been repeatedly proved by experimenting with 368 varieties that there exist a number of varieties of rice plants which are resistant to *Helminthosporium* disease. Among about 60 resistant varieties. "Bôzu", "Meshibu", "Kobara", Shiga-sekitori", "Ishijiro", "Iwateakabo" were estimated as the most promising, though their resistance to the disease is relative and still far from the absolute immunity. No varieties which are resistant to all these important diseases have yet been determined.

In order to obtain success in breeding varieties which possess both desirable morphological characters and disease resistance, the author recommends co operative experiments of plant pathologists and plant breeders, and the following steps are proposed to be taken. 1) Planting as many varieties as possible in the field where the disease is prevalent, with application of double amount of nitrogenous fertiliser so as to obtain a more susceptible growing condition of the plants, and then select the resistant varieties or strains, which are to be repeatedly cultivated under the same condition for a certain period to ascertain the results. 2) Repeated inoculation to be carried out with plants potted in large test-tubes or porcelain pots, to obtain identical results. For the latter purpose, the author used large glass test-tubes of 24 cm × 2.4 cm., containing white sand, c. c. of soil extracts and 5 c.c. of Knop's solution. To obtain enough quantity of the inoculum, the author found convenience in using large petri-plates of 18 cm. in diameter.

The disease resistant character as a Mendelian factor is favored in the case of the rice plant; and as far as it has been able to determine, no increase of virulence of the parasite (*Helminthosporium Oryzae*) was found by starvation, leaving the spores in a saprophytic condition over 5 years, which naturally denied the possibility of adaptation of the parasite to the unfavourable conditions. Physiological difference of various strains of *Helminthosporium Oryzae* is also stated to be very slight.

T. T.

311. Resistance Trials of Dutch Varieties of Potatoes to the "Spots Circle Disease", and Black Scab.

Paper by H M QUANJER Prof of Plant-Pathology at Wageningen, presented by Dr J J L. VAN RJJN, Delegate of the Netherlands and the Dutch Indies at the International Institute of Agriculture

Amongst the diseases of the potato, there are some of which the injurious effects depend in the first instance upon the susceptibility of the varieties cultivated which is even more variable in the case of the "spots circle disease" (*maladie des taches en couronne*) and of black-scab, or wart-disease, than in that of potato mould (*Phytophthora infestans*)

The first-mentioned disease made its appearance on potatoes grown in sandy soils manured with dung. It occurs in the form of brown patches on the pulp of the tubers. In the Dutch varieties "Eigenheimer" and "Borger" these patches are arranged in a circle or crescent, in "Roode Star" they are distributed irregularly. The cause of this disease is still unknown, but SYDNEY G. PAIN, of the London Imperial College of Science and Technology, has announced his intention of making a communication on this subject at the International Phytopathological Congress to be held at Wageningen in June 1923

An experiment was made in 1922 with the object of testing the resistance shown to this malady by 40 Netherland varieties of potato and a few foreign varieties

The potatoes were planted in soil severely infected by the disease, three plots of each variety being grown between rows of "Eigenheimer". Each of the control plants of "Eigenheimer" produced contaminated tubers. "Roode Star", "Bravo", and "Bleue de Zélande" also proved very susceptible. The "Institut de Beauvais" (a French variety), "Industrie" (German), and "Topas" (Czecho-Slovakian), were but slightly infected. Few of the varieties were entirely immune. Among these "Triumph", a new variety produced by VEERKAMP, a plant-breeder, of Nieuw-Compagnie is chiefly worthy of notice

Nearly all these varieties have been tested for their resistance to wart disease (caused by *Chrysophlyctis endobiotica*). This disease crossed the German frontier some years ago and has penetrated into the north of the Netherlands. Dr CURT WIJN BOTJES has carried out the following experiment at Oostwold. Three plots of each variety were cultivated between rows of "Bravo", one of the kinds most susceptible to the malady. The fact that "Bravo" was generally attacked proves the heavy infestation of the field. Among the badly infected varieties may be mentioned, "Bleue de Zélande", "Eigenheimer", and nearly all the varieties of VEENHUIZEN, a plant-breeder of Sappemeer. "Roode Star" from the same breeder was fairly resistant, the warts being only of small size on these tubers. "Industrie", on the other hand, is very susceptible. "Institut de Beauvais" has not yet been grown on this field, its susceptibility will be tested next year. VEERKAMP's "Triumph" is one of the small number of varieties that proved immune. Since this variety is also resistant to the "spots-circle disease", has a fairly good flavour, and produces a

heavier crop than any of the new varieties created in Holland of recent years, it will take the first place in that country. It is a semi-early variety with yellow pulp.

312 Control of Cotton Wilt by the Use of Potash Fertilizers.

RAST, L. F. (Agronomist, Little Rock, Arkansas) *Journal of the American Society of Agronomy*, Vol 14, No 6, pp 222-224, figs 3 Geneva, N. Y., 1922

Various manuring experiments were made during 1920, in Arkansas, in cotton plantations on fine, sandy, argillaceous soil. The manures were applied in the proportion of 500 pounds per acre, or 560 kg. per ha.

On land where a manure containing 10 % of phosphoric acid, 3 % of nitrogen and no potash was used, all the cotton plants were affected by wilt.

In the following year the author suggested that an equal quantity of kainite, containing 12.5 % of potash should be added to the same manure; no plants were diseased and there was a yield of 1127 pounds of seed per acre (1263 kg. per ha.) against 225 pounds (252 kg.) on unmanured land. The addition of kainite was not less beneficial to growth started on land which had been manured in the above mentioned manner. I, V

313 New Measure for controlling Apple-Tree Canker (*Nectria ditissima*).

MACÍÑRRA, F. El chancho canceroso del manzano y un nuevo tratamiento eficaz para combatirlo *El Cultivador Moderno*, Year XII, No 5, pp 11-12, figs 2 Barcelona, 1922

On an estate situated on the north coast of Spain in the immediate neighbourhood of Cape Estaca de Bares (Galicia), at the mouth of the Sor, many of the most vigorous apple-trees belonging to the choicest varieties, as soon as they are 4-8 years old became seriously and in some cases fatally, attacked by canker (*Nectria ditissima* Tiel).

The hardy Galician and Russian varieties, on the other hand, not only proved very resistant to the disease, but if they were attacked suffered less, none of the trees, or any large number of the branches, being killed. Therefore it would appear that the best method of protection against canker is to grow only varieties of apple which are least susceptible to the malady.

Since canker made its appearance various measures have been adopted to save the infected trees.

The cancerous parts of the bark of the trunk and main branches were cut away, the wounds being carefully scraped and then disinfected with 50 % "zotal", after which the trees were thoroughly pruned.

The trees in which the disease was in the initial stage were sprayed with 15 % Bordeaux mixture, after the infected portions and all dead tissue beneath them had been removed, and the wounds were subsequently disinfected.

Spraying with petroleum and "zotal" was also tried, but none of these treatments gave entirely satisfactory and lasting results

At the beginning of 1918 an experiment of quite another kind was made. Three vigorous apple-trees of five or six years of age, which had been severely attacked by canker were chosen. Their large lower branches were cut away near the base, the cut being made in a horizontal direction, and the surface was scooped out with a gouge, so as to form a small groove at the end of the mutilated branch. A little copper sulphate (the exact amount was not noted) was dissolved in about half a litre of water and poured into the groove which was then covered over with a piece of canvas tied on with string, a further quantity of the solution was added every eight to ten days to replace the amount absorbed by the tissues. In addition, the large wounds on the trunk and on the remaining branches were treated, all the dead portions excised, and the cuts brushed over with very strong Bordeaux mixture. This first attempt was crowned with success. The old canker sores did not spread any further, and five years after the operation there was no sign of a reappearance of the disease, the trees producing a heavy crop of excellent fruit.

This experiment with some modifications was repeated in 1921, on five other apple-trees seriously attacked by canker. In the trunk of each of them a hole of small diameter and with a slope of about eighty degrees, was bored by means of a gimlet and gouge at a height of one to one and a half metre from the ground. Then a little cup was made with grafting-clay at the entrance to the hole. From March 12 to April 27, a solution of 200 gm. of copper sulphate in 2 litres of water was gradually introduced through the cup into the cavity, more being gradually added as it was absorbed by the tree, and the hole carefully covered with a piece of canvas. The trees were thoroughly pruned and all their canker wounds treated.

Four or five months after this operation a narrow longitudinal lesion appeared in the bark, and the latter became dry from the site of the perforation almost to the level of the ground. This lesion was probably caused by the strong concentration of the solution injected. Perhaps it would be advisable to use a 4 %, or even weaker solution, instead of the 10 % solution. Apart from the above-mentioned cortical lesion, three of the trees have so far remained healthy and bear vigorous shoots and fine crops of apples. The fourth tree produces less strong shoots, while the fifth which was very sickly at the time of the experiment, although it developed no lesion of the cortex, has withered in consequence of root-rot (1).

A simple and effective means of combating canker is to make an incision down the trunk in the spring and along the chief branches, on the most sheltered side of the strongest-growing apple-trees, as these are the most susceptible to canker. Trees thus treated are less likely to be infected with canker, or even if the disease attacks them, it assumes a mild form,

(1) As regards the use of injections with other substances for the control of other parasites on different plants, see: *R* 1915, Nos. 235 and 1103; *R* 1916, No. 596; *R* 1920, No. 366; *R* 1922, No. 215 (*Ed*).

while the young shoots of diseased trees which have been incised grow very strong and remain perfectly healthy

It has been found that the best substance to apply to all wounds on fruit-trees and especially those due to apple-canker, is a thick-paste made of crude sardine-oil (from the pickling-factories), mixed with powdered ferric oxide. This must be applied with a brush and trowel after the wounds have been cleaned and freed from all remains of cankerous growth

G. T.

314. Rice Disease and the Hot Water Seed-Treatment in the Southern United States.

TISDALE V. H. Seedling Blight and Stack-Burn of Rice and the Hot-Water Seed Treatment. *United States Department of Agriculture, Bulletin* No 1110, pp 1-11, figs 2, plates 6. Washington, D. C., 1922

American rice-growers and dealers give the names of "stack-burn", "stain", or "flecking" to a disease which shows itself in the form of small brownish-yellow spots, or a total discoloration of the grain which reduces the commercial value of the grain and also its viability, so that sometimes the fields have to be re-sown

The disease does special injury in the southern parts of the United States. Although produced by other causes it bears much resemblance to the affection known in Europe as "yellow grains". The Office of Cereal Investigations has given attention for some years to the causes and best means of controlling stack-burn, which does most injury when the weather is very damp during the harvest, and the rice sheaves are left for a long time in the field in order to dry them. If the grain is piled up in heaps in damp store-houses after threshing, it becomes similarly affected

The pathogenetic agents seem to be plant parasites. On the diseased caryopses various fungi may be found (*Epicoccum*, *Penicillium*, *Aspergillus*, *Fusarium*, *Pyricularia*, *Helminthosporium* and *Sclerotium*), but *Sclerotium* is probably the chief parasite, as has already been assumed by HUMPHREY and GODFREY, for it also produces similar spots on the leaves of the rice plant

In order to prevent the disease being transmitted to the seedling, different methods of treating the rice seed have been tried. Superficial disinfection by immersing the grain for 3 minutes in 50-70% alcohol and then for 10 minutes in a 1/100 solution of bichloride of mercury does not give satisfactory results as the *Sclerotium* mycelium is not thereby destroyed. It can, however, be killed to a large extent, if not entirely, by putting the grain into hot water, as the Japanese investigators NISHIKADO and MIKAKI have already demonstrated. In view of the structure of the rice grain which is tightly enveloped in adhesive glumes, it is well to soak the caryopses first for a considerable time (about 16 hours according to the author) in tepid water, which renders the subsequent hot water treatment much more effective. The best results are obtained by putting the grain for 15 minutes in water at 54° C, this kills the fungus without altering the germinating capacity of the grain. The author has found that under the same

conditions different varieties of rice show varying degrees of susceptibility to the disease which points to the selection of resistant lines and varieties as being the best means of solving the problem of the control of "stack-burn"

G. B. T.

315 *Ustilago Eleusine* n. sp. Injurious to the Graminea *Eleusine coracana* in the Presidency of Bombay (India).

KULKARNI, G. S. The Smut of Nachani, or Ragi (*Eleusine coracana* Gartin) *The Annals of Applied Biology*, Vol. IX, Nos. 3-4, pp. 184-186, figs. 2. London, 1922.

In October 1918, it was observed for the first time at Malkapur (State of Kolhapur), and later also in other parts of the Presidency of Bombay (Surat, Nashik and Ratnagiri) that the ears of *Eleusine coracana*, a Graminea popularly known under the names of "nachani" and "ragi", presented an unusual appearance owing to the presence on one side of the rachis, or near the apex, of certain grains protruding from the glumes. These abnormal kernels occurred either isolated, or in groups, and were round, or elongated. They were not only larger than normal grains, but differed from them in colour, sometimes being pink while yet unripe and turned chocolate-brown, or glossy black, when they became dry.

An examination of the affected grains revealed the presence of a new species of *Ustilago* which the author describes under the name of *Ustilago Eleusinis*.

It appears probable from the results of a small cultural experiment that the disease is transmitted by the infected grains. The best method of controlling it is to soak the seed before sowing in a 2% solution of copper sulphate.

G. T.

316. Report on the Tobacco Disease, called "Slijmziekte" in Sumatra.

SIDENIUS, E. and SCHMOLE, J. F. Slijmziekte en reboisatie *Deli Proefstation te Medan* *Ulugschrift*, No. 17, pp. 3. Medan, 1922.

It is a well-known fact that the type of vegetation growing on tobacco-land during the time when it is not planted with tobacco, is of very great importance, especially as regards the disease termed "slijmziekte". Very few experiments have yet been made on the subject, which is due to the circumstance that these experiments are — and ought to be — of long duration. In 1915, at the suggestion of Dr. K. DIEM, an experiment was begun at the Experimental Station at Deli, in Sumatra. The object of this experiment was to study the influence of several species of plants on the disease in question. The results obtained were so remarkable that it was decided to publish them in a concise form at the present time.

The experiments were carried out as follows: The ground was divided into square plots measuring 8 × 8 m. (132 tobacco plants) and each number was repeated 12 times. It was known that the soil was strongly infected with the disease. Experiments were made with the following plants. "Tjente" (*Lantana Camara*), "Peteh Tjina" (*Leucaena glauca*),

"Orok-Orok" (*Crotalaria striata*), "Lalang" (*Imperata arundinacea*), "Ramboetan oetan" (*Passiflora foetida*), "Koeljingan" (*Mimosa invisa*), "Ketepeng" (*Desmodium gyroides*).

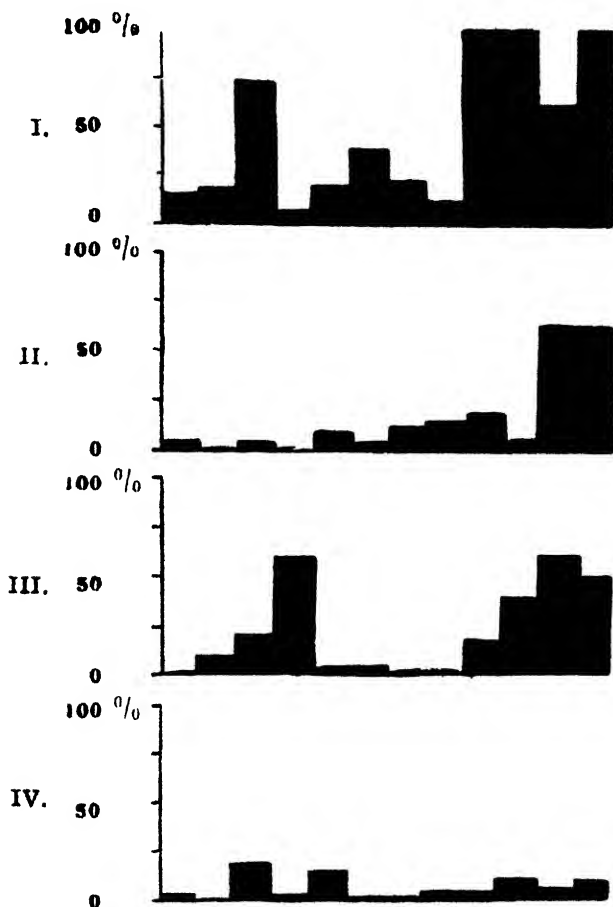


Fig. 66 — Intensity of disease

- I. *Lantana camara*
- II. *Lantana glauca*
- III. *Imperata arundinacea*
- IV. *Mimosa invisa*

Twelve plots were left to themselves and became overgrown with a miscellaneous admixture of all sorts of plants. In 1921 it was found that only the following plants had been able to keep their positions: *L. Camara*, *L. glauca*, *I. arundinacea* and *M. invisa*. The other plants had

disappeared, to a greater or less extent, or had been smothered by the weeds.

Early in 1922 tobacco was planted. Precautions were taken to avoid the carrying of infection from plot to plot by means of soil adhering to the implements or feet of the man

During the period of growth any plants which were diseased were removed and examined in order to discover the disease.

On the plots 47 % of *L. Camara*, 16 % of *L. glauca*, 22 % of *I. arundinacea*, and 6 % of *M. invis*a were killed by the disease.

A graph illustrates (see fig. 66) the extent of the disease on the 12 parallel plots. This shows that on some plots 100 % of Lantana were killed by the disease. The influence on the disease of the type of vegetation on the tobacco soil, is distinctly shown. Consideration of these results indicates that it is a question of increasing as much as possible, the growth of *L. Camara* on tobacco land. The experiments with *M. invis*a should be continued

D V. S

317 *Fusarium* sp., a Parasite of Various Plants in Uganda.

SMALL, W. On the Occurrence of a Species of *Fusarium* in Uganda. *Royal Botanic Gardens Kew Bulletin of Miscellaneous Information*, No. 9, pp. 269-291, figs. 13. London, 1922

The same species of *Fusarium* reported from Uganda in 1920 as causing the withering of carnations and also of *Delphinium*, *Nigella* and *Cosmos* has since made its appearance there on seedlings of other plants viz., cashew nut (*Anacardium occidentale*) Silk oak (*Grevillea robusta*), Rose apple (*Eugenia Jambos*) and "loquat" (*Eriobotrya Japonica*). The *Fusarium* produces a very serious form of wilt on the first of these new host-plants, its effect upon the others is less noticeable, but by no means negligible. It has also been found associated with the root-knot eelworm (*Heterodera radiculicola*) on carnations and *Antirrhinum* which has led to a more thorough study of its behaviour

In April 1921, 100 % of the young *Anacardium* seedlings were severely attacked, the symptoms being as follows: a softening of the hypocotyl axis, disorganisation of the tissues and root-rot. A large amount of mycelium was present in the infected parts. This mycelium, on cultivation, bore micro- and macro-conidia, and intercalary and apical chlamydospores. It was found possible to produce the disease artificially also on *Delphinium*, *Manisera* and *Spondias*. Seedlings of *Grevillea*, *Eugenia*, and *Eriobotrya* having been similarly attacked in the nurseries, it is probable that we have here to do with a species of *Fusarium* able to live as a saprophyte in the ground and to attack different species of plant, either directly, or by means of superficial lesions.

As regards the identification of the parasite, the author believes it to be *Fus. udum* Butl. a fungus found in India on *Cajanus indicus* (pigeon-pea). His opinion is based both on the morphological and cultural characters of the *Fusarium*, as well as upon the fact that when *Cajanus indicus* is sown on ground where there are infected seedlings of *Anacardium* the

former at once become attacked by a disease with characters resembling those described by BUTLER. In order to be certain, however, it is necessary to obtain the ascophorous form of the fungus which has not hitherto been possible

G B T

318 *Trametes robinophila*, a *Polyporea* injurious to *Robinia* in Michigan.

KAUFFMAN, C H and KERBER, H M A Study of the White-Rot of Locust, Caused by *Trametes robinophila* *American Journal of Botany*, Vol. IX, No. 9, pp 49, 508, figs 3 Lancaster, 1922

The study of the disintegration processes taking place in the wood of trees affected by heart-rots is important, not only from the scientific, but also from the practical standpoint, especially if the wood is to be used for certain purposes, such as for instance, the construction of aeroplanes. The authors' work on the White Heart-Rot of *Robinia Pseudo-Acacia* is a valuable contribution to our knowledge of the subject. The work was carried out in South Michigan with a view to ascertain the macroscopic and microscopic characters of the rot itself, the way it spreads, the distribution of the mycelium in the various parts of the diseased trunk, and the effect produced upon the different wood elements.

In *Robinia* wood attacked by rot due to *Trametes robinophila* Murr., three areas can be distinguished viz

1) A black marginal area consisting of a narrow irregular blackish-brown band, $\frac{1}{4}$ - $\frac{1}{2}$ mm in width, separating the apparently healthy wood from the diseased zone

2) A zone with less disintegration, on the inner side of and adjoining the marginal zone and distinguished from the external, apparently healthy portion by its yellow, or brownish, colour. The wood in this zone is still intact, and can be cut without falling to pieces, but it is softer and lighter than the healthy wood

3) A zone of advanced disintegration, situated internally to the preceding zone. In this, the wood is of the same yellow colour, but it is traversed by longitudinal bands of wood fibre that are very deficient in lignin

The wood in this region is of quite a different consistency, having become so dry and brittle that it cannot be clean cut, but falls to pieces when merely pressed by the fingers. The mass of infected wood is completely disintegrated in time and falls out, leaving a cavity in the trunk.

The micro-chemical tests carried out on the different xylem elements (cells of the medullary rays, tracheids, and wood vessels, wood parenchyma and woody fibre) in the various zones show that the alteration is due to the hyphae of the fungus dissolving the lignin present in the xylem elements by means of enzyme action.

No hyphae are met with in the marginal brown zone, but there are evident signs of their passage in the minute circular holes made in the wood parenchyma, and in the characteristic erosion of the internal walls of the tracheids and wood vessels. The contents of the cells of the

medullary rays and of the wood parenchyma are transformed into a brown mass.

In the succeeding zones, the perforations made by the hyphae are larger and more numerous, although here again no mycelium is to be found.

The histological elements of the internal zone are so greatly altered as to be unrecognisable, but no hyphae are present even here, though they are very numerous in the apparently healthy wood, this, however, is actually diseased, as was proved by the authors, who measured its resistance to pressure, of which they give some numerical data.

As regards the absence of hyphae in those parts of the wood that are evidently altered, the authors are disinclined to attribute it to the disintegration of the mycelium owing to the exhaustion of nutritive material, or to reabsorption, for in either of these cases the hyphae would at least be visible in the marginal zone. The hypothesis that the mycelium has been destroyed by bacteria which have penetrated into the wood through the perforations made by the fungus, does not seem any more probable. The investigators are of opinion that most probably the disintegration is caused by enzyme substances produced in large quantities by the mycelium during its presence in the altered tissues, but they consider further research to be necessary before the problem can be finally solved

G. B. T.

319 Studies on the Blister Disease of *Cryptomeria* Seedlings.

KITAJIMA, KIMIZÔ. Suginae no Ganshubiyô ni kwansuru Kenkyû *Ringvô Shikenjô Hôkoku* (Report of the Imperial Sylvicultural Experiment Station), No 18, pp 155-168, 1 colored pl (Japanese). 1922

In 1914, a fungous disease of nursery plants of *Cryptomeria japonica* attracted the attention of the author as a disease hitherto unknown. The disease is caused by a new species of fungi, *Valsa Cryptomeriae* Kitajima, the nature of which was fully ascertained in 1917. The fungus usually attacks the green stem of the seedlings causing a discoloration of blackish-brown or reddish-brown color. The infected area becomes sunken and cracked. This checks the growth of the shoot causing either bending or hypertrophy which is followed by gradual dying off of the upper portion. The fusoid swelling is often very conspicuous which characterises the disease from other maladies. The original description of the fungus is given

The physiological characters of the fungus differ from *Valsa Paulownae*, its nearest ally, in being more resistant to tannic acid and more susceptible to citric acid. The fungus is entirely killed in 7 hours by 3-5-50 Bordeaux mixture.

T. T.

*Weeds and Parasitic Flowering Plants.*320. **Remarks on the Parasitism of *Olax imbricata* in the Philippines.**

HERBERT D. A. The Parasitism of *Olax imbricata*, *The Philippine Agriculturist*, Vol. XI, No. 1 pp. 17-18. Los Baños, Laguna, 1922.

Olax imbricata is a woody, climbing-plant found growing wild on Mount Makiling. The family of the Olacaceae is closely related phylogenetically with the two families of the Loranthaceae and Santalaceae, both of which orders are noted for their numerous members living as parasites on the branches, or roots of other plants. That the parasitic habit should be common among the Olacaceae is therefore to be expected, and in fact, one of them, *Olax scandens* possesses haustoria by means of which it attaches itself to the roots of its host, as has been shown by BARBER. The author has now found similar haustoria present in *O. imbricata* which has not the appearance of a heterotrophic plant, since its leaves are well-developed, although its parasitic character is clearly proved by an examination of its roots. *O. imbricata* has an extensive, but superficial, radicle system and the finer ramifications, on coming into contact with another root, send out lateral haustoria of the type found among the Santalaceae. In shape, a mature haustorium much resembles a small agaric with the pileus situated outside the root of the host-plant, the lamellae closely adpressed to the surface of the latter, and the stipe buried in its cortical tissue. The vascular tissue of the haustorium is arranged like an inverted flash with the mouth in contact with the wood of the root of the host, so that by means of this sucker the parasite is able to absorb nutritive salts, water and organic substances from its victim. In *Olax*, as in all root-parasites, autoparasitism is by no means rare, therefore haustoria developing in contact with one of the roots of the parasite itself are always of greater size, since they find a supply of nutritive substances better suited to the needs of the plant. *Olax imbricata* was found parasitic on three species of plants, two of which were Leguminosae, while the other is not specified by the author.

G. B. T.

321 **The Vitality of the Seeds of Wild Plants.**

MUNERATI, O (Direttore della Stazione sperimentale di Bieticoltura id Rovigo) La conservazione della vitalità dei semi delle piante spontanee in superficie del suolo. *Nuovi Annali del Ministero di Agricoltura*, Year II, No. 2, pp. 243-249 Rome, 1922

The author has made a study of the preservation of seeds in fields and the means by which weeds are propagated. He made experiments on 22 species of wild plants, almost all of them typical weed pests which grow in the lower Valle Padana. The work was begun in the summer-autumn period of 1915, and continued until the end of March 1921. The ground selected was a piece of land that had been hoed for years, and was therefore presumably free from living weed seeds. The author divided the plot

into squares by means of plates of zinc, and placed in each division a certain number of mature seeds (200 — 300 — 400 — 500) which had been collected the same year from plants. Every test was triplicated. As soon as the seeds germinated they were taken away. Although the germination conditions were so unfavourable, the seeds being on the surface of the ground, they retained their vitality and viability for five years, some of them even being alive in the sixth year. Thus seeds, are resistant to rapid changes of temperature, recurrent frost, the alternation of moisture and drought, as well as to the direct action of light and of oxygen.

It may happen that more seeds of one species germinate at the same time after a resting period; this would account for the sudden periodic appearance, in number seemingly out of all proportion, of specimens belonging to a given wild species.

Naturally, a higher or lower percentage of seeds varying according to the species had lost their viability and did not germinate.

The author's experiments perhaps explain why the repeated summer-autumn field-work recommended with a view to bringing the weed seeds to the surface where they can germinate quicker and more easily is in truth of little use in the control of noxious weeds that propagate themselves by seeds. The only really effective method is to prevent these plants ripening their seed.

L. V.

Animal parasites.

322 Observations made in Central France on the *Platyedra vilella*, a Microlepidopteron similar to the Cotton Pink Bollworm.

DE JOANNIS, J. Note sur la chenille de *Platyedra vilella*, Z (Lep. Gete chidae, *Bulletin de la Société entomologique de France*, No 16, pp 247-250, figs 1 Paris, 1922

Amongst the European species resembling the pink bollworm (*Depressaria gossypiella* Saund = *Gelechia gossypiella* = *Pectinophora gossypiella* = *Platyedra gossypiella*) the *Gelechia malvella* Hb. and *Platyedra vilella* Z. deserve special attention

In the flowers of the Malvacea *Lavatera arborea*, during the first week of July, 1921, and again just before mid-June 1922 in the Le Net district, on the Ruis peninsulas and in the flowers of *Malva sylvestris* in 1922, on the Island of Arz has been observed larvae, which on examination has been identified as *Platyedra vilella*. These larvae appear to be parasitic on the flowers and seeds of *L. arborea* and *M. sylvestris*, and feed on the seeds.

The description of the larvae does not correspond exactly with that noted by E. MEYRICK (1895) in his studies on the life history of the same Microlepidopteron. Is it possible that two distinct species are to be found the adults resembling each other in appearance?

G. T.

323. Natural enemies of the Olive Fly. (*Dacus oleae*) and of *Prays oleaellus*, observed in Spain.

CODINA, A. Els enemics naturals dels insectes depredadors de les olives I. Dos endofegs de la mosca de la oliva (*Dacus oleae* Rossi), nous per a Espanya. Un ectofag de l'arna de la olivera (*Prays oleaellus* F.) nou per a la província de Tarragona. *Bulletin de la Institució Catalana d'Història Natural*, 2^a ser. Vol II, No 3, pp 58-73, figs 4. Barcelona, 1922

During 1918, a collection was made in various localities in the Provinces of Barcelona, Tarragona, Lerida and Malaga of olives damaged by *Dacus oleae* Ro. 1 and by *Prays oleaellus* Feb., with a view to investigation as to possible natural enemies in Spain.

On olives coming from Tarragona (Alcamar and La Cenia), three Hymenoptera were noted, the *Eupelmus urozonus*, Delm. and *Eulophus longulus* (Zett.) Thoms., parasitic on the Olive Fly and *Ageniaspis fuscicollis* (Dalm.) Thoms. Subsp. *praysincola* Silv. parasitic on *Prays oleaellus*.

Eup. urozonus and *Eul. longulus*, are new to Spain; *Ag. fuscicollis* subsp. *praysincola* is new to Tarragona. G. T.

324. The Use of Zinc Phosphide in Agriculture.

MAROGNA, G. and FRATTALI H. (R. Stazione Chimico-Agraria di Roma) Sull'impiego di fosfuro di zinco in Agricoltura. *Nuovi annali del ministero dell'Agricoltura*. Year II. No. 2. pp 257-277. Rome, 1922.

Phosphide of zinc is a more or less impure substance represented by the formula P_2Zn_3 is used for the control of field-voles and has lately been adopted for the destruction of locusts. Formerly this compound was made only in Germany, but now it is also manufactured on a large scale in Italy.

In the control of fieldvoles, poisoned baits made of maize, wheat, oats, rice, beans, chickpeas, or sunflower and hemp seed are used, these substances being coarsely ground, moistened with water and mixed with 15 % of phosphide. For locusts wheat bran mash containing 5-8 % phosphide is effective and good effects have been obtained by dusting the phosphide over any infested plants, or by spraying them with mixtures containing 1 % of the phosphide.

As phosphorus is very expensive, zinc phosphide cannot compete with other poisonous mixtures having a base of arsenic, lead, copper, barium etc., but it is useful in destroying animal pests.

Many objections have, however, been raised against it, both from the hygienic and the practical standpoint. In the first place, zinc phosphide is dangerous to handle in itself, and also on account of the hydrogen phosphide which is easily liberated in the presence of moisture. Other equally, or more toxic compounds, such as arsenical mixtures and hydrocyanic gas are however used in practical agriculture. In view of the danger involved in the liberation of hydrogen phosphide, the Ministry of Agriculture in Italy has forbidden poisoned bait containing zinc phosphide being made indoors, or near any dwellings.

Hydrogen phosphide has a penetrating odour, resembling the smell of garlic, which drives all animals away, but the bait afterwards loses its toxic properties owing to the further transformations that take place in the zinc phosphide.

The authors have carried out a series of experiments in order to ascertain the nature of these transformations. They used a paste of wheat bran and crushed maize moistened with water. The results show that decomposition takes place much more rapidly in the presence of organic substances than in water, but if the phosphide exceeds 3-4 % of the dry matter the bait is effective for several days. The decomposition is greater and more rapid when the substances are very finely subdivided, as in the case of phosphide dust ("*fosfuro ventilato*") which must be used in a rather stronger concentration. The decomposition of the zinc phosphide, and the accompanying production of hydrogen phosphide, is greatest during the first 1-2 days after mixing. Subsequently it continues to decrease, even if the bait is kept moist. The acidity of the bait increases up to about 1.1 % (expressed as acetic acid). The addition of alkalis in proportions a little higher than is necessary to neutralise the acidity makes the decomposition slower, but does not prevent it. The effect of sodium bicarbonate, sodium phosphate and precipitated calcium carbonate was similar. After 10 days, 32-44 % of the zinc phosphide was decomposed without the addition of any neutralising substance; if any alkali was introduced, 15-23 % of the ordinary phosphide and 27-32 % of the powdered ("*fosfuro ventilato*") was decomposed. Zinc phosphide that falls on the ground undergoes slow decomposition. Even in concentrations of 1 part per 100 of soil, which can never be attained in practical work, most of the phosphide is decomposed after 8 months. The process takes place more rapidly in humiferous soil than in marl, and is hastened by moisture. Zinc phosphide "dust" ("*fosfuro ventilato*") decomposes more quickly than ordinary zinc phosphide. The figures obtained range from 65.2 % in the case of ordinary phosphide in dry marl, to 100 % in that of phosphide "dust" in soil which was kept damp and has a high content of organic matter. From this standpoint, zinc phosphide is superior to arsenical compounds, as these retain their toxic properties almost indefinitely.

I. V.

325 The Pink Boll Worm (*Platyedra gossypiella*) in Egypt.

GOUCH, I. II On the Dispersion of the Pink Boll Worm in Egypt
Ministry of Agriculture, Egypt Technical and Scientific Service, Bulletin
No 24, pp 1-21 Cairo, 1922

The author undertook this biostatistical study with the object of discovering the conditions that regulate the dispersion and intensity of the attacks of *Platyedra gossypiella* (pink boll-worm)

This insect lays its eggs and passes through its larval stage during the vegetative development of the cotton boll which it infests as long as it is green viz, about fifty days. Each boll can harbour several caterpillars; sometimes twenty larvae are found in a single capsule

The author bases his remarks chiefly on the relations between the percentage of infestation and the percentage of bolls with different numbers of larvae, and shows the remarkable parallelism existing between the calculated data and the results of observation. The conclusions, which only apply to the variety under consideration, "Sakellarides" cotton, though they may serve as a guide to research on other varieties and in other districts, are thus formulated by the author

1) The dispersion of the boll-worm in the cotton capsules follows certain definite rules ;

2) for every given percentage of infestation it is possible to calculate the number of bolls containing respectively 0, 1, 2, 3, 4, or more larvae (thus, if the percentage of infestation is 30, 70 of the bolls ought to be free from caterpillars, and there should be 21 with only 1 caterpillar, 6.3 with 2 larvae, 1.89 with 3, 0.57 with 4, 0.17 with 5, 0.05 with 6, and 0.02 with 7) ,

3) the injuries are in direct proportion to the number of larvae infesting the boll ,

4) the damage occasioned by one caterpillar amounts to about one-tenth of the product of the boll its has attacked ,

5) once the infestation percentage is known, it is possible to calculate the percentage of capsules with larvae in 0, 1, 2, 3 loculi, for it has been found that about one larva out of four injures more than one loculus

6) from the study of the reported facts, it is clear that if averages are required they should not be calculated from the infestation percentages, but the figures obtained for the infestation percentages must be converted into the number of larvae per each 100 bolls, or into the percentage of injury occasioned

G B T

326 *Polydrosus pilosus*, Coleopteron Injurious to Various Coniferae in Switzerland (1).

BARBIY, A. Une nouvelle invasion du charançon des aiguilles du sapin blanc *Polydrosus pilosus* Gredl *Journal forestier suisse*, Year 73, Nos. 8-9, pp 157-159, tables 1 Berne 1922.

In the summer of 1922 in several parts of Switzerland, severe damage was done to *Coniferae* spp by the Coleopteron *Polydrosus pilosus* Gredl and the effect of this in subsequent years may be serious.

P. pilosus has not only attacked the seedlings and the under wood, but has also damaged the tops of the trees. The needles have a corroded appearance. In the Bioleyre forest (Vaud), and especially on silver firs, the terminal shoots were seen to be completely deprived of their leaves. As a general rule, the wide-spreading trees exposed to the sun's rays were

(1) See R 1922, No 676 Ed)

the worst attacked. In 1921, it was observed that the spruces were severely injured by this Curculionidae. In the Bioleyre forests, only certain larches and a few *Pseudotsuga Douglasii* specimens were defoliated. In the valley of the Travers and of Ruz (Neuchâtel) and also in Alsace, damage to pines has been reported. In all probability *Pol. pilosus* may be found over a large portion of Central Europe.

This pest evidently confines its attacks to the warm and dry weather; this was proved in the first half of June 1922.

It is probable that in 1923, further damage will be done, as no effective and practical means of control has yet been devised. G. T.

BIBLIOGRAPHICAL NOTES.

327. QUANJER H. M. and HUDIG, J. De Aardappelschurft met betrekking tot klimaat en boden. *Cultura*, Year XXXV, No 412, pp 1-12, pl 2, bibliography Utrecht, 1923

Description of Potato Scab (*Actinomyces* [*Oospora*] *Scabies*) relative to climate and soil, with special reference to its connection with soil reaction (1). D. v. S

- 328 ALDRICH, J. N. *Anachaetopsis vagans* n sp a Dipteran Parasitic on the Codling Moth (*Carpocapsa pomonella*), in Oregon. *Entomological News*, Vol XXXIV, No. 2, pp 53-54 Philadelphia, 1923

This paper gives a description of a new Tachinid, *Anachaetopsis vagans*, obtained by rearing it artificially at Medford (Oregon), on September 6, 1922, from the Codling Moth (*Carpocapsa pomonella* L.) The new American species is very nearly related to the European *Anach ocyptcrina* Zett. G T

(1) See R 1919, No 531; R 1923, No 1 (New Edition) (Ed.)

CURRENT NOTICES

Legislative and Administrative Measures.

Legislation in 1922 concerning Chambers of Agriculture in Austria (Lower Austria). — I. Law relating to the creation of Chambers of Agriculture, Feb. 22, 1922 ; establishment and organisation of professional agricultural representation, functions and scope of Chambers of agriculture. Chambers of Agriculture are expected to consider suggestions and proposals made relating to all agricultural questions, to advise upon the requirements of Agriculture, proposed legislation and other measures affecting agricultural interests, the establishment of institutions intended to further agricultural progress, the exportation of agricultural products and technical agricultural education. The Chambers are empowered and required to co-operate and take part in the administration of agricultural public business, to develop agricultural production in all its spheres, to establish and manage institutions and establishments for the advance of agriculture, to advise the rural population on all economic and technical questions relating to agriculture, to send representatives to all organisations and bureaux dealing with agricultural questions, to give certificates as regards customary law practice in the agricultural sphere

The Law also lays down regulations for the relations of Chambers of Agriculture with other Authorities, their constitution, methods of election, vacancies and suspensions of members and general rules of procedure, receipts, dissolution, internal Office arrangements together with certain temporary provisions

II) Law prescribing rules for the election of members of Chambers of Commerce, Feb. 22, 1922. The law relates to the Electoral College, Election Committees, list of voters, qualifications of candidates, method of voting, procedure for assessments, the filling of casual vacancies

III) Law relating to the compulsory vote for Chambers of Agriculture, Feb. 22, 1922.

IV) Decree relating to elections to Chambers of Agriculture, March 7, 1922 (*International Institute of Agriculture, Bureau of Legislation, Textes législatifs de l'année 1922, No 25*)

Bulgarian law on forests. May 1, 1922. — A law dealing with property in forest areas ; the object of forest development ; the management of forests ; saw mills, replanting ; roads and buildings ; control of streams ;

funds for development schemes in the sphere of agriculture, woods and forests ; penal and transitory arrangements (*International Institute of Agriculture. Bureau of Legislation Textes legislatifs de l'année 1922*, No. 22).

Law to regulate the importation of adult bees into the United States of America. August 31, 1922. — With the object of preventing the introduction and propagation of dangerous diseases in adult bees, the importation into the United States of bees (*Apis mellifica*) in the adult stage is forbidden and all adult bees intended for importation into the United States must be destroyed unless they are immediately re-exported (*International Institute of Agriculture. Bureau of Legislation Textes legislatifs de l'année 1922*, No. 25)

French Legislation in 1922, to secure improved usage of wheat and wheat flour. — 1) A law for securing an improved usage of wheat and wheated flour 2) Decree establishing conditions for the application of the preceding law 3) Decree modifying the preceding decree 4) Order fixing the conditions for the establishment of a recognised official type of pure wheat flour 5) Order modifying the preceding order 6) Order relating to the terms in which requests for licences for the manufacture of flour of a lower extraction rate than that of pure wheat flour should be presented 7) Order modifying the preceding order 8) Order relating to the constitution of Departmental Consultative Committees 9) Instructions for the application of the preceding measures 10) Decree relating to the addition of substitutes for pure wheat flour 11) Decree supplementing the previous decree 12) Instructions for the application of the preceding decrees (*International Institute of Agriculture. Bureau of Legislation Textes legislatifs etc. for the Year 1922*, No 21)

Order relating to trade in nuts in France. Sept. 6, 1922. — This order forbids the sale, exposure for sale, transport, import or export of nuts from any single source, or mixed nuts from various sources, under a false declaration of origin. The inspectors and agents for the suppression of adulterations will take such samples and obtain such information as may be necessary to bring to court offenders against the terms of this order by applying the laws of Aug 1, 1905 (*International Institute of Agriculture, Bureau of Legislation Textes legislatifs de l'année 1922*, No 23)

French Laws. — Law of December 5, 1922, reducing the period in which returns for the wine harvest should be made

Law of December 7, 1922, modifying articles 6 and 8 of the law of April 5, 1920, on co-operative credit and agricultural co-operation

Law of December 15, 1922, extending to farms the legislation on accidents incurred by workmen during working hours.

Decree of December 5, 1922, establishing a register of selected plant varieties and setting up a Committee for Seed Control

Circular of the Ministry of Agriculture relating to the preservation of potatoes.

Circular of the Ministry of Agriculture on measures to be taken with the object of encouraging the increased cultivation of spring wheat

Law of December 8, 1922, allowing Departments and Communes special advances taken from the agricultural credit with the object of facilitating the

application of the law of October 31, 1919 as regards the holding of small properties by workers and large necessitous families.

French official decrees etc. — Decree of December 31, 1922, repealing the decree of May 27, 1921 (rules for the road) and containing general orders for road and traffic police

Decree of January 9, 1923, with regard to the application of the law of December 8, 1922, allowing Departments and Communes special advances from the agricultural credit with the object of facilitating the holding of small properties by workers and large necessitous families

Order of the Ministry of Agriculture of January 19, 1923, referring to the issue of certificates of inscription in herd-books, etc

Order of the Ministry of Agriculture of January 20, 1923, establishing in the Ministry of Agriculture a Committee for the drafting of decrees and administrative regulations in connection with the extension to farms, of legislation on accidents incurred by workmen during working hours

Order of the Ministry of Agriculture of January 31, 1923, relating to the consignment of potatoes introduced into the area infected by doryphora and in the area of protective control

Circular of the Ministry of Agriculture of February 3, 1923, addressed to the Directors of the Agricultural services and relating to the market prices of wheats and flours

General Inspection of Agriculture in France. — By an Order under date of January 15, the Minister of Agriculture recommends to the special attention of General Inspectors of Agriculture the following subjects upon which they will be required to draw up a joint report to be presented to the Minister at the end of the year :

1) questions connected with vinegrowing, 2) book-keeping and control; 3) agricultural education, 4) the dairy industry. 5) Breed Syndicates; 6) Herd-Books, 7) potatoes, 8) beetroots, textile fabrics and national fuel material, 9) wheat and pedigree seeds; 10) fruit production; 11) cultivation of oleaginous plants, 12) agricultural labour

Agricultural Machines in Tunis. — A decree amending the general tariff of import Custom dues fixed by the decree of May 19, 1920.

Ex 522 — Agricultural machines, not including engines, cream-separators and detached portions to cream-separators, to pay an import duty of 60 % of their value (*Journal Officiel tunisien*, January 3, 1923)

Phosphates in Madagascar. — Decree authorising the working, under certain conditions, of the phosphate deposits of the Colony (*Journal Officiel de Madagascar*, November 25, 1922)

Official Documents relating to the French Colonies and Protectorates. — *Guadaloupe* : Decree regulating the trade in poisonous substances, their detention and use in Guadaloupe (*Journal Officiel*, December 15, 1922).

Ivory Coast : Decree determining the amount of Ivory Coast cacao to be imported free of duty during the year 1923 (*Journal Officiel*, December 24, 1922).

Togo : Decree altering the quantity of Togo cacao to be imported into France free of duty (*Journal Officiel*, November 21, 1922).

French Equatorial Africa : Decree amending the duties on woods, coffee, or cacao, imported into the portion of F. E. A. situated between the basin of the Congo, as delimited, and granting exemption of duty to certain products of F. E. A (delimited basin) imported into France (*Journal Officiel*, December 16, 1922)

Cameroon : Decree prohibiting the importation, trade and detention of opium products in the territories of Kamerun (*Journal Officiel*, November 7, 1922)

Decree altering the amounts of Cameroon cacao which may be imported into France with rebate of Custom dues (*Journal Officiel*, November 21, 1922).

Decree fixing the quantity of coca from the Cameroons which can be imported under the French mandate with rebate of Custom dues during the year 1923 (*Journal Officiel*, December 24, 1922)

Reunion : Decree removing Reunion from the list of Colonies infected with the Coffee-bean Scolytid (*Journal Officiel*, November 17, 1922)

Madagascar : Order for the promulgation in the Colony of the Decree of August 6, 1922 modifying the Custom dues on tapioca, sago, salop and manioca flour (*Journal Officiel de Madagascar*, October 28, 1922)

Tunisia : Order of the Director General of Finances authorising, until further notice, the importation of Port and Madeira wines of Portuguese origin (*Journal officiel tunisien*, November 15, 1922)

Decree authorising the exportation of oils from oil-factory residues, and of oil-factory residues to any destination and in any quantities without special permit (*Journal officiel tunisien*, December 6, 1922).

Morocco : Dahir relating to the importation into Morocco of potatoes for good purposes (*Bulletin officiel du Protectorat du Maroc*, November 1922)

Dahir relating to the temporary admission of wheats (*Bulletin officiel du Protectorat du Maroc*, November 14, 1922)

Dahir suppressing rights of export of wheat and wheat derivatives (*Bulletin officiel du Proctorat du Maroc*, November 21, 1922)

Potato Preservation in France. — M CHÉRON, the French Minister of Agriculture, has sent a circular to the Departmental Directors of the Agricultural Services requesting them to give some information on the above subject to agriculturists. Potatoes on being lifted are divided into 3 lots, perfectly sound tubers that can be stored for a long time, diseased or injured tubers that must be consumed at once, and suspected tubers, most of which be used as soon as the diseased potatoes are finished. Some of the suspected tubers can be kept; if the disease is confined to a small area, the affected portion can be cut out and the wound will heal over if the potato is exposed to the air. Diseased potatoes supply sound, commercial starch. Potatoes will keep perfectly if they are stored in silos provided with ventilating tubes at distances of every 3 or 4 metres, as by this means the temperature of the potatoes is kept at 5 to 6° C. The tubes can be removed during frost and replaced as soon as the temperature rises (*Le Génie Civil*, Vol. LXXXII, No. 1, pp 19-20. Paris, 1923)

Inspection and grading of Fruit for Export from South-Africa. — The *Union Government Gazette* of 22nd December 1922, contains Regulations issued by the Department of Agriculture in notification No. 2,041 making

provision for the inspection, grading, marking and packing of fruit intended to be exported from the Union. The Regulations provide, *inter alia*, that all fruit for export shall be in sound condition, fully developed, not too unripe, free from disease, bruises, cuts or other blemishes affecting its appearance, and shall be of the characteristic shape of its variety; and furthermore, that all fruit in one box shall be of uniform size and of one variety, except fruit consigned to private order, in which latter case the box shall be so marked on the end thereof (*Board of Trade*, Vol CX, No 1366 London, Feb. 1, 1923).

Importation and Sale of Vegetable Seeds in Bermuda. — Regulations made by the Bermuda Board of Agriculture on 28 November, 1922, provide that on and after 1 July, 1923, only certain varieties of vegetable seeds of the kinds specified in the Regulations may be sold in the Colony, and that a sample from each consignment of imported vegetable seeds shall be forwarded to the Director of Agriculture to be examined for vitality and trueness to type. All imported seeds found to be of low vitality or untrue to type or infested with any dangerous disease may be seized by the Board of Agriculture, but the importer shall have the right to return the seeds to the shipper, provided it is done to the satisfaction of the Board (*The Board of Trade Journal and Commercial Gazette*, Vol CX, No 1366 London, Feb 1, 1923).

Importation of Broom Corn restricted in Canada. — A Circular No 242 C), issued by the Canadian Department of Customs and Excise on 15th January, 1923 states that all broom corn from foreign countries, other than the United States, offered for importation into Canada shall be accompanied by a certificate of inspection and sterilisation, if considered necessary, issued by the Federal Horticultural Board, stating that the consignment in question had been duly treated in accordance with the regulations dealing with the importation of broom corn into the United States, viz, Quarantine 41 of the United States Department of Agriculture (*Board of Trade*, Vol CX, No 1368 London, Feb 1923).

New Zealand Law dealing with the Protection of Animals, the Closed Seasons, and the Creation and Powers of Acclimatisation Societies. — This law deals with the protection of wild animals (different kinds of game, including opossums), game reserves, Acclimatisation Societies, and general regulations. It contains a list of animals that must not be killed, (this includes 55 species of birds) and a list of the game that has been introduced into the country (*International Institute of Agriculture, Textes législatifs de l'année 1922*, No 20).

Law dealing with the Appointment of a Commission of Meat Producers for the Control of the New Zealand Meat Export Trade. — **February 11, 1922.** — This Commission shall include two members appointed by the General Government and nominated by the Minister of Agriculture to represent the Government of New Zealand, and five members nominated by the Governor-General to represent the producers of meat for exportation, the said members being elected in the prescribed manner. (*International Institute of Agriculture, Textes législatifs de l'année 1922*, No. 27).

Stringent Measures against the Importation of Plants into Italy.

— The Official Bulletin of the Ministry of Agriculture (Year II, Part 3, pp. 213-214, Rome, 1923) has published a list of plants that may not be imported into the Kingdom of Italy, or which are subject to certain phytopathological regulations

Japanese Law: Kachiku densenbyô yobô hô. — Law relating to the measures for the control of contagious diseases in domestic animals, April 6, 1922 (*International Institute of Agriculture Textes législatifs de l'année 1922*, No 26)

Regulation relating to the Importation of Seeds and of Living Plants into the Dutch Indies. — The introduction into the Dutch Indies of India-rubber seed, living India-rubber plants or portion of the said plants from South America is prohibited, the introduction of seeds, living plants, and portions of living plants, other than those specified above, as well as of their fruits and packing material, is only permitted under Art 4 and 6 of the present regulation, in the case of the places indicated by the Directors of Agriculture, Industry and Commerce, and if they are provided with a certificate signed by a Government expert of the country of origin, or by an official of a Society of that country, on which is stated the species of plant to which the imported material belongs, its place of origin, and a declaration to the effect that it is free from all diseases due to animal or plant, parasites. The other articles of this Regulation treat of expert control, expenses incurred, infringements of rules etc (*International Institute of Agriculture, Textes législatifs de l'année 1922*, No 25)

Importation of Plants into Uruguay. — By order of the " Consejo Nacional de Administración " of Uruguay, under data of December 22, 1922, paragraph A of the first article of the decree of March 24, 1922 dealing with plant importation, is to be replaced by the following

A) Every consignment of plants, parts of plants and of fresh fruit shall be accompanied by an immunity certificate granted by the competent authorities of the country of origin stating that the goods have been subjected to phytopathological inspection and found to be free from all disease

Experiment Stations and Agricultural Instruction

Experimental Beekeeping Station in Germany. — This station has been recently founded at Manster in Westphalia. Special studies will be made of the problems of Modern Beekeeping particularly with regard to breeding, heredity, hives and the diseases of bees. Attached to the Station are a laboratory, Museum, garden, etc.

The Luiz de Queiroz de Piracicaba, School of Agriculture, State of San Paolo. — The Director, F. F. de Souza Reiz gives a description in a fully illustrated volume of the organisation on the most modern lines and the very complete equipment of this school, which was founded in 1908, together with an account of its history and schemes of work. Admission is by examination or on presentation of a certificate of higher secondary instruction taken in a Government or equivalent institution. The number of admissions is limited and the writer recommends that it should not exceed 40. It is also possible to obtain admission if, after the elementary school stage,

a one-year preparatory course, followed by a three-year special course, has been taken. In the School itself there are four courses of instruction; 1) a one-year preliminary course; 2) a three-year general course; 3) a one-year recapitulation course; 4) a course in agricultural practice. Of these the two first are compulsory, the two last are optional. The recapitulation course is open only to those who can produce the agricultural diploma which is granted at the end of the general course. During the eleven years 1908-1919, 277 such diplomas have been awarded by the school.

New York Experiment Station. — The Director of the New York Agricultural Experiment Station has drawn up a programme of work for the next ten years. Research and experiments will be made on a number of subjects, including the following — the cultivation of new varieties of small fruits and vegetables, the conservation of fruit juice, fruits and dried vegetables; chemical and bacteriological studies on milk and dairy products, studies on soil moisture, plant physiology, the relations of birds to agriculture, etc. (*Science*, Vol. LVII, No. 1462, Washington, January, 1923)

Agricultural Experiment Station of the University of Missouri (U. S.). — The Station has had the advantage of the cooperation of the U. S. Department of Agriculture in a number of important schemes — *Soil Survey*: For many years the Bureau of Soils has been co-operating with the Agricultural Experiment Station in completing detailed soil surveys of the Missouri counties. The Bureau of soils has not only assisted directly in the examination of soils but has printed nearly all of the Reports on the surveys of the Missouri counties — *Beef Cattle Survey*. The departments of animal husbandry and farm management have co-operated with the Bureau of Animal Industry in a beef cattle survey. The results of this survey will be of great value — *Seed Testing Laboratory*. For many years the Station has co-operated with the United States Department of Agriculture in a seed testing laboratory located in the Agricultural Building at Columbia. The work of this laboratory has been of great service to Missouri. The Station is also working in conjunction with the Office of Cereal Investigations of the Bureau of Plant Industry, and with the Bureau of Agricultural Economics upon a study of land prices.

Popularisation of Agricultural Science in the United States. — MERCIER W. B. (Assistant Officer of Extension Work in the South States, Relations Service). *Status and Results of Extension Work in the Southern States 1903-1921. United States Department of Agriculture. Department Circular 248*, pp. 1-38, Washington, November, 1922.

Report on the popularisation of Agricultural Science in the Southern States by means of demonstrations in the country districts. This campaign is being carried out by the Office of Extension Work in the Southern States which acts in conjunction with similar Offices appointed for the Northern and Western States respectively.

Garden for the Propagation of Tropical and Sub-Tropical Plants in the United States. — This garden of 850 acres is known as the Chapman Field Air Station and is situated on the shore of Biscayne Bay, south of Miami, Florida. Since 1898, the Department of Agriculture of the State of Florida has owned a Plant Introduction Garden of 7 acres and a Research Laboratory at Miami, and in 1914 it became possessed of a garden of 25 acres at Buena

Vista. Its new acquisition is intended to be a Centre of Tropical Agricultural Research and the garden will be under the Management of the Bureau of Foreign Seed and Plant Introduction, of the Bureau of Plant Industry.

For Testing Tillage Implements. — *Farm Implement News*, Vol. 43, No. 21, p 17 Chicago, May 25, 1922.

The University of Nebraska has made a course for testing ploughs and other machines for working the soil. A trench 160 ft. long, 12 ft. wide and 3 ft. deep was filled with earth. Water-pipes were laid down to insure the soil being sufficiently damp. The bottom of the trench to a depth of 6" is composed of crushed stones to allow the water to find its way under ground. The surface soil is a clayey-sand and extends to a depth of 30." The soil is uniformly compact, and as the track is sheltered, the temperature varies little. The tests were made to determine the effect of speed and depth upon the tractive force when different types of mouldboards are used. The ploughs are drawn by an electric trolley with a speed ranging from $\frac{1}{2}$ mile to 4 miles per hour. This trolley runs on rails laid down on both sides of the trench, and the ploughs can be attached at any point.

Stock-Feeding in France. — A regional experiment stock-feeding centre has been established by the "Institut de recherches agronomiques" and the "Office agricole regional du Nord". This centre will include calorimetric, physiological-chemical and stock-feeding Services. Its programme of work includes: the study of the milk-yield obtained by feeding different vegetable foods to cows, estimating the food value of different kinds of bran, the study of the development of economically reared calves, milk-testing (*Journal d'agriculture pratique*, February 3, 1923).

Agricultural Education of Women in France. — It has been decided by the law of August 9, 1921 that the instruction of young women shall be given in special National Schools of Agriculture. A decree published in the *Journal Officiel* of February 9, 1923, lays down the rules for the conduct of these Institutions, which apply to the first to be opened, the Higher School of Household Management, which has up to the present been carried on at Grignon. This first National School for young women will be established at the School of Coetlogon at Rennes, which has been modified for the purpose (*Journal d'Agriculture pratique* February 17, 1923).

Institute of Viticulture at Laquenexy (France). — The Department of Agriculture has decided that, as in previous years, young people, at least sixteen years of age, can be admitted in the capacity of students to the Institute of Viticulture at Laquenexy as from the spring of 1923. They will receive theoretical and practical instruction in the most important branches of annual viticultural work including growth from seeds, making cuttings, grafting, bedding out and setting in the nurseries, care of nurseries; cutting back and disbudding; anticyptogamic treatment and control of insect pests; hybridising, choice of old and new grafting stocks and their adaptation to the soil and climate of Alsace and Lorraine; wine making and the treatment and care of wines. This course will last from March, 1 to October 15, and the students will be allowed a summer vacation.

The instruction will be given in French, though if absolutely necessary both French and German may be used. No charge is made for the course

but students must pay for their board and lodging though the Department of Agriculture is prepared to assist by means of grants, covering approximately the cost of maintenance. Requests for admission and for all further information should be made to M. Ambriot, Director of the Institute, at Laquenexy (P. O. Courcelles-Nied) (Moselle) (*Revue de Viticulture*, Year 30, Vol. LVIII, No. 1494, Paris, February 15, 1923).

University of Cambridge: Chair of Animal Pathology. — An important new development of the Agricultural School of the University is foreshadowed in an offer from the Ministry of Agriculture and Fisheries announced by the Council of the Senate. In the first instance the offer is of a sum of £30,000 from the Development Commissioners to provide for the establishment of a Chair of Animal Pathology. On appointment, the Professor will be requested to prepare a scheme for the development within the University of the study of the diseases of farm animals. For an approved scheme the Commissioners would be prepared to find a capital sum of about £25,000 for buildings, the sites to be provided by the University. While the Corn Production Acts (Repeal) Act Fund lasts, i. e. till about 1927, annual grants for maintenance and research would be met out of the Fund. After the Corn Repeal monies come to an end the Ministry confidently expects to find from other sources the money necessary for carrying on the work. In the event, however, of the necessary financial provision not being forthcoming, the University would be under no obligation to continue the Institute. Both the Schools of Agriculture and Medicine should gain greatly from this new scheme, and work of the utmost importance for the live-stock branch of agriculture will be initiated (*Nature*, No. 2780, Vol. III, February 10, 1923).

Official Seed Testing Station at Cambridge (England). — The second course of training for seed analysts will commence in July at the Official seed testing Station, Cambridge, and will last four or five weeks. The course is limited to those who are nominated by Seed Firms, recommended by Universities or Agricultural Colleges, or otherwise show their fitness for such training. At the conclusion of the course, an examination will be held which will also be open to nominated candidates who have not taken the course of instruction.

Rowett Research Institute at Aberdeen. — The announcement has been made of a gift of £5,000 by a donor, who at present wishes to remain anonymous, to the Rowett Research Institute for Animal Nutrition at Aberdeen. This sum is intended to found a library and to provide for making statistical records (*Nature* No. 2779 Vol. III, London, February, 1923).

Experimental Poultry Breeding Station at Rovigo (Italy). — La Stazione sperimentale di pollicoltura di Rovigo (*Il Giornale agrario*, Year 4, No. 44, p. 4, Bologna, 1922).

The equipment of this station was completed in 1922, the work of poultry rearing began in January 1923. The fowl-runs, except those fitted up with houses for chickens, are divided into 3 classes.

1) Show runs, of these there are 15 made partly of masonry and partly of wood. They differ in size and type, some have windows that can be closed, and are thus suited to delicate breeds and for cold, damp climates; others are provided with a netting front adapted for hardy fowls or for warm climates.

2) Pens for the selection of Laying Breeds. These are 24 in number, 16 have open fowl-houses, and 8 have fowl-houses that can be closed. They are made to hold one cock and six hens. The selection of the best layers is made by means of trap-nests.

3) Breeding-runs, these are 4 in number and occupy an area of some 18 sq m and are provided with fowl-houses, each holding about a hundred head of poultry.

Institute of Biological Research at Upsala (Sweden). — The Swedish Government has made a grant of 60 000 crowns to Dr. H. LUNDBORG's Institute at Upsala for biological research on heredity and racial characters. It is proposed to make a section for biopathology and a museum for collections of specimens illustrative of hereditary factors

Machine Testing Station in Switzerland. — On November 18, 1922, were inaugurated the cantonal Agricultural Schools and Stations of Macelin-s-Morges. These include not only an Agricultural and a Housekeeping School, but also Stations where research and experiments are made in the various branches of agriculture and rural economy, information concerning which on application is given. One of these Stations has been set apart for testing agricultural machines and has already commenced work (*La Terre Vaudoise*, January 6, 1923)

Congresses and Conferences

World's Bee-Keeping Congress. - This Congress will be held at Quebec, Canada, in September 1923

World's Dairy Congress (National Health). — **Business — Sanitary Control — Science.** — Meeting to be held at Washington, United States of America from 2 to 5 October, 1923

The President of the United States invites all nations to send official representatives

Invitation. — Societies, Research Institutes, Commercial firms and private individuals engaged in the production, manufacture, distribution and use of dairy products are invited to take part in the Congress, or to send their authorised representatives. The twenty-three National Syndicates of the Dairy Industry in the United States associate themselves with this invitation which is sent to their colleagues throughout the world.

Place of Meeting — The International Congress, the first to meet after nine years, will be held at Washington, District of Columbia, United States of America from 2-5 October, 1923

Need of the Congress - Since the war, the important place held by dairy products in the commerce of the world has been recognised and a new idea has been formed of the great influence of milk upon the health of children and the physical strength of nations. The large amount of unpublished information at present available makes this an opportune moment for the exchange of the most recent knowledge acquired throughout the world on this subject

Work - The chief authorities on the questions of the production, manufacture, distribution and use of dairy products from the scientific, economic,

dietary and sanitary standpoints will speak at the Congress Scientists, professors, officials, authors, journalists, cattle-owners and dairy proprietors, manufacturers of dairy products and utensils, distributors, export and import traders, private individuals interested in infant welfare and social questions, persons engaged in the study of dietetics and domestic economy, doctors, nurses and philanthropists will all take part.

Washington, the capital of the United States, will be the centre for this work, the aim of which is the advancement of the dairy industry as in that city are situated laboratories and experiment stations, the United States Bureaux of Statistics and Political Economy, the Ministries of Agriculture and of Commerce, and the Federal Sanitary Services

Programme of the Congress:

I *Research and Education*. 1) Education, 2) Milk production, 3) Feeding of dairy cows, 4) Milk secretion and milk chemistry, 5) Bacteria in connection with the dairy industry, 6) Dairy products, 7) Serious diseases of dairy cows

II *Industry and Economics*: 1) World's production and trade a) cattle, b) products, 2) Milk production. a) Management of dairy farms, b) cost of production, c) quality, 3) Manufacture: a) Milk-supply of towns, b) butter, c) cheese, d) condensed milk, e) ice-cream, f) milk powder, g) other products or by-products, 4) Marketing: a) methods, systems and costs, b) transport, c) finances, d) cattle markets, e) manufacturers' trade-marks, f) advertising and sale methods, g) storage, h) statistics, 5) equipments

III *Regulation and Control*: 1) Regulations and methods of control, 2) Uniformity of regulations, 3) Milk, grades and quality, 4) Dairy products, 5) Control of adulteration, 6) control of diseases of animals

IV *National Health*: 1) Food value of milk, 2) Use of milk in tropical regions, 3) Education of the public in the use of milk

Excursions — Excursions will be made of much interest from the standpoints of industry, science, history and natural scenery. A visit will be made to the *Seventeenth National Dairy Show* at Syracuse, New York State, which will take place from October 6-13, 1923. The dairy industry of the United States will be well represented, for shows of dairy cows and milk products are to be held, as well as exhibitions of labour-saving and scientific apparatus and illustrations of the work carried out by the Government, the Universities and the Sanitary Services (See page 537 *The Seventeenth Annual National Dairy Show at Syracuse, N. Y.*)

Visitors will be welcome at the breeding and dairy farms, at the town depôts, the factories of products and machines, the hospitals and the research and educational institutions

Passenger Tickets — The Steamship Companies will take passengers at very reduced rates, but bookings must be made early. Information will be supplied by the American Express Co., Messrs. Cook and Sons, Messrs. Bennett and other tourists agencies.

The World's Dairy Congress Association (address 426 Star Building, Washington, D. C. United States of America) will be happy to give information as to routes, secure hotel accommodation etc., for any persons desirous of making personal visits to any special locality. Intending visitors requiring

further information are requested to send their names and addresses to the Delegates

Congress of French Live-Stock Herd-books, etc. organised by the "Société nationale d'Encouragement à l'Agriculture" conjointly with the "Office français d'élevage", at Paris, on May 7 and 8, 1923. The objects of the Congress were to fix : 1) the technical principles on which the Herdbooks, Registers, etc are based ; 2) the definition of the various breeds , 3) the definition of the standards ; 4) means of identification of the animals ; 5) necessary methods of control.

Modern methods of keeping Herdbooks will also be brought forward. The results obtained at the Congress will at once be laid before the XI International Congress of Agriculture. Bureau du Congress, 5 Avenue de l'Opéra, Paris.

Meeting of the British Association for the Advancement of Science, at Liverpool. — The British Association will meet at Liverpool from September 12-19, 1923. The question of Virus Diseases will be discussed in the Physiological and Agricultural sections. Much work of great biological interest has recently been done on the subject of these diseases. Plant physiology will occupy a prominent place in the programme. The connection between plant growth and assimilation will be discussed, as well as the scientific aspects of electro-cultivation. The relative importance of hydrogen-ion concentration will be one of the soil problems dealt with. Morphological questions and mycology will be made the subjects of special meetings.

In Section K (popular lectures), a lecture will be given on cotton. Excursions may possibly be made to the Isle of Man, the sand-dunes near Liverpool, and to the Great Ormes Head on the Welsh coast. In the course of the Soirée, there will be an exhibition of laboratory apparatus and botanical specimens in the Hartley Botanical Laboratories (*The New Phytologist*, Vol XXII, No. 1 London, February 20, 1923)

House and Farm Management Union, Milan. At the Poultry-Breeding Congress held at Asti (Italy), in September 1922, the Secretary of the Farm Management Union explained the work of this body, which is to improve the hygienic conditions of dwelling-houses, stables, piggeries and hen-houses, and interests itself in problems connected with bee-keeping and rabbit-breeding.

First Conference of the Society of the Agriculturists of France. With the Minister of Agriculture in the Chair, and in the presence of a large audience, the President of the Society inaugurated, on January 19, a series of lectures to be held during the winter of 1923. The subject of the lecture was "International Organisation of Labour and Agriculture". The President first reminded his hearers of the provisions of the Treaty of Versailles which created the International Conference and the International Labour Bureau, and then passed on to show under what conditions this Institution can be useful to the world at large and overcome the practical difficulties it may meet both in its inner working and in its relations to the different States. With regard more especially to agricultural questions, it may be remembered that the permanent Court of International Justice at The Hague has passed judgement in favour of the authority of the International Bureau of Labour

which had been disputed by the Government and the Agricultural Associations. This finding of the Court created a new situation which the Government accepted, an example that agriculture must perforce follow, in spite of her previous opposition. Further, it should not be forgotten that the decisions of the International Labour Conference, which are based on the studies of the International Bureau, and may take the shape of a "recommendation" to be brought to the notice of the States with a view to its being given effect in the form of a law, or may be the "subject of an agreement" to be ratified by the States under certain conditions, but no compulsion can be brought to bear upon the States in question.

In conclusion, the President stated his opinion that France had more to gain than to lose by taking part in the international study of the social problems which present themselves to all nations, and that her position in the world would insure the success of her efforts.

Wheat Day in Rome (Italy). -- Wheat Day was celebrated on January 1 1923 in the hall of the Circolo Roma, 5 Piazza Grazioli. This day had been set apart for the discussion of the serious problems connected with wheat production in Italy.

Question List: 1) Can Italy cultivate and produce the wheat she needs? 2) If this is possible, what means must be adopted to insure an adequate supply? 3) Can wheat be regarded as a paying crop, and if so, in which areas? 4) What other crops give a higher yield? 5) What other crops sell well in foreign markets? 6) Political side of wheat question

Olive-tree Day in Rome, Italy. -- The March 18, 1923, was kept as "Olive-tree Day" at the Circolo Roma, 6 Piazza Grazioli. This day had been appointed for discussing for the first time and in thorough manner, the different questions connected with olive-oil production, a very important branch of agricultural industry. Programme: 1) Problems relating to olive-tree cultivation; 2) Control of the parasites attacking the olive-tree; 3) Scientific manufacture of olive-oil; 4) Medicinal oils; 5) Protection of olive-oil against adulteration; 6) Taxation of land under olive-trees

Exhibitions and Meetings

International Exhibition of Domestic Hygiene (foods etc.) was held at Antwerp (Belgium) from May 19-June 10. -- For particulars, apply to M. Jos Verhulst, Palais de Glace, 9 Rue de la Santé, Antwerp, Belgium.

International Agricultural and Industrial Exhibition at Riga (Lithuania). -- The exhibition will remain open from July 22 to August 5, 1923, and will have 32 sections. The agricultural sections will be as follows: 1) Agricultural machines and implements; 2) Agriculture, horticulture and vegetable gardening; 3) Forestry and peat-bogs; 4) Stock-breeding; 5) Dairy Industry; 6) Poultry-breeding; 7) Bee-keeping; 8) Pisciculture.

International Piscicultural Exhibition at Leeds, from September 24 to October 6, 1923.

International Competition of Rice Drying-Machines. -- This competition will be held, at Vercelli (Italy) in the autumn of 1923. Programme:

1) An international exhibition and competition of rice drying-machines will be held during the harvest season of 1923. The exhibition has been organised by the R. Stazione sperimentale di Riscicoltura di Vercelli (Experiment Station for Rice-Growing at Vercelli) under the patronage of the Ministry of Agriculture and various Associations. 2) Italian and foreign investors and constructors may exhibit either directly, or through their agents in Italy. 3) An Organising Committee will be appointed to take the measures necessary for the success of the competition. The Chairman of the Committee will be the President of the Vercelli Riscicultural Station and will be assisted by the Head of the Mechanical Section in the capacity of Secretary-General of the Committee. The Committee is composed of the delegates of the Ministry and of the Associations represented. The Organising Committee shall be empowered to admit additional members having the right of discussion without voting. 4) A special Judging Committee elected by the Organising Committee is present at the trials, awards the prizes and submits a report to the Organising Committee. 5) Prizes will be awarded to those complete apparatus that best fulfil all the required conditions e. g. dry the rice perfectly while reserving intact all its physical, physiological and hygienic properties, work most economically and regularly and are easiest to handle. The prizes awarded are: a) First diploma of honour with large gold medal, presented by the Ministry of Agriculture, to be given to the best rice-drier; b) Second diploma of honour with gold medal, presented by the "R. Stazione Sperimentale di Riscicoltura", to be given to the rice-drier considered as second in order of merit. A diploma of honour with gold medal is also offered for the best movable drier having all the qualities set out in Art. 5. The judges have also at their disposal, three other gold medals with diplomas, to be awarded to different appliances, or arrangements of original character and practical application forming part of driers, even if the latter have not gained a prize in their entirety. Competitors must apply for registration not later than May 31, 1923 giving their names and addresses and the number and type of machines they desire to enter. They must also forward at the same time, drawings of the machines and practical working instructions, as well as data respecting the production of the driers, working-costs, price of the complete plant and normal sale conditions. All applications to be addressed to the Organising Committee of the Rice-Drier Competition, the "R. Stazione di Riscicoltura", Vercelli. The Committee will forward forms of application. 8) Competitors must inform the Committee, not later than the 31 of next July, of the place where they wish to carry out their tests these must be made, except by special permission of the Organising Committee, in the Provinces of Bologna, Mantua, Milan, Novara, or Pavia. 9) Every machine must be started by its constructor, or his authorised representative who is required to furnish the judges with any information they may request; 10) the competitors must carry out all the appointed tests and demonstrations in the manner laid down by the Organising Committee and the judges; 11) all the expenses of the above tests and the cost of the rice, fuel, energy etc. are to be defrayed by the competitors who shall, however, have no right to sue the Organising Committee, or the judges, for any moral, or material, injury sustained during the course of the competition.

International Rubber Exhibition at Brussels. — The Sixth International Exhibition of rubber and other tropical products and of the connected industries will be held at Brussels in April 1924, under the patronage of His Majesty the King of the Belgians and with the cooperation of the Belgian Government. The Exhibition will be held at the same time as the Commercial Fair organised by the city of Brussels; it will enjoy the official support of the Fair, and will be held in the same building, the Hall of the Cinquantaire Applications for accommodation and all other communications to be made to H. GREVILLE MONTGOMERY, Organising Director, or to MISS EDITH A. BROWN F. R. G. S., Overseas Delegate, Exhibition Offices, 43 Essex St. Strand, London, W. C. 2.

Worlds Poultry Exhibition at Barcelona (Spain). May 1924.

The International Executive Committee of the World's Poultry Congress and Exhibition at Barcelona met on December 11 and 12, 1922 at Paris and decided that the Congress and Exhibition should be held from May 10 to 20, 1924.

Home Colonisation Exhibition and Week in Germany, in 1923.

Owing to the uncertainty that prevails in respect to all matters concerned with house-building and home-colonisation, all the experts whether technical or administrative members of the building industry, persons interested in home-colonisation, architects etc., have agreed to meet before the beginning of the new season in order to consider the possibilities of home-colonisation this year. The employees of the Ministries will communicate the resolutions passed and the measures taken by the Government, but not yet published. One of the subjects under discussion will be the means by which the colonists can become self-supporting. Other matters dealt with will be colonisation by workers, the condition of the land and of building materials, the grouping of houses and gardens, the best means of building small houses, etc. The meetings will be held at the Labour Ministry. All novelties connected with the subject will be on view at the Exhibition. The preparations and the work will be carried out with the assistance of the "Volkwohlfahts Ministerium" and in conjunction with the "Verband der Deutschen Landkreise" the "Gesellschaft zur Förderung der inneren Kolonisation" and the "Deutsches Archiv für Siedlungswesen", Berlin, Luisenstrasse 27-28. The Exhibition will last from 22 February-22 March, the Home Colonisation Week will end on March 3. (*Mitteilung der Deutschen Landwirtschafts Gesellschaft*, February 17, 1923).

Horticultural Exhibition at Tangiers in May 1923.

Agricultural and Industrial Exhibition at Durban from 3-6 July. — All communications to be addressed: Durban and Coast Society of Agriculture and Industry, 399 Smith Street, Box 503, Durban, South Africa.

Fourth Swiss Exhibition of Agriculture and Food Industries.

This exhibition will be held at Lausanne, from 8-23 September, 1923.

The Seventeenth Annual National Dairy Show at Syracuse, New York. — This exhibition will take place from 6-13 October 1923, immediately after the World's Dairy Congress. The show is an annual one and allows the visitor, in the spaces of a few days, to grasp the chief aspects of the dairy industry.

as a thousand of the best dairy cattle of the United States and of Canada will be shown. The buildings cover several hundred thousand square feet. The latest developments in machines for the manufacture and distribution of dairy products will be on view. The Cattle and produce to be shown by the students of the Agricultural Colleges form very interesting items in the programme. For all information, apply to W. E. SKINNER, Manager, National Dairy Association, 910 South Michigan Avenue, Chicago, Illinois, U. S. A.

Show of Chrysanthemums, Dahlias, Cannas and the Tunisian Flowers, Fruits and Vegetables in Season. — The Bureau of the "Société d'Horticulture de Tunisie" will arrange for this show to take place on October 28, 1923; only members of the Society are allowed to compete. The exhibits may be: plants in pots, cut blooms, labelled specimens and floral decorations. There will be a section for medicinal, and perfume plants; the exhibits may be shown as dried plants, fresh plants and pot specimens. Each competitor is requested on registering his name, to state where the plants he intends exhibiting have been grown. Subject to the wish of the prize-winner, the medal to be awarded may be replaced by its value in money.

British Industries Fair, London, Feb. 1924. — Owing to the great success of the British Fair which was held this year, it was at once resolved to organise a similar fair for next year. This fair will take place from 18-24 February 1924, at Shepherd's Bush. Enquiries to be addressed to the Department of Overseas Trade (Exhibitions and Fairs Division), 35 Old Queen St., London, S. W. 1

Postponement of the Agricultural Exhibition of Hamburg (Germany). — It has been found necessary to give up the idea of holding the 50th Agricultural Show at Hamburg which should have taken place in June of this year. At the meeting on January 25 last, the President of the "Deutsche Landwirtschaftlichen Gesellschaft", at the request of the Schleswig-Holstein Chamber of Agriculture resolved to defer the Hamburg Exhibition until the year 1924 and to discontinue, for the present, the work of preparation. Probably, a small exhibition will be arranged with the cooperation of the "Wanderversammlung" to take place during next autumn in some German town.

Machine and Implement Tests in Germany. — Although the Hamburg exhibition has been put off until next year, the machine tests arranged for this year will take place. The tests will be for: potato planters, potato harvesters, machines for treating clover seeds, grass seeds etc.

Show of White Charolais Breed at St. Amand (France). — On the suggestion of the "Fédération des Sociétés d'Agriculture du Centre", an arrangement has been made between the Stock-Breeding Syndicates and the Society for popularising the White Charolais breed, by means of which in future the four exhibitions and sales of selected breeding stock shall be held successively at Charolles (the original home of the Charolais breed), Saint Amand, Nevers and Moulins (*Journal d'Agriculture pratique*, February 17, 1923)

Paris Agricultural Exhibition. — This exhibition was opened on February 15, 1923 at the "Grand Palais of the Champs Elysées". It included an International Poultry Show (11 000 birds) a section for flowers,

fruit and vegetables, a honey fair, a large exhibition of various beverages (wines, ciders etc) and an exhibit of 50 cattle of the chief French breeds. In addition, the Institute of Agronomic Research showed a collection of insects and cryptogams, useful or injurious to agriculture.

Report of the National Seed Fair (France). — The National Seed Fair which was opened at the side of the Agricultural Machine Hall (January 20-28, 1923), was a source of great interest. Like the preceding fairs, it had been arranged by the Seine Departmental Office and formed a harmonious whole. There were about 50 exhibitors at the fair: 6 Production Associations, 11 producers and 34 merchants of which a certain number were also producers. The Fair was of an international character, some of the exhibits came respectively from Sweden, Czecho-Slovakia and Belgium. Three well-known associations of the restored Provinces should first be mentioned, viz., "Association d'amélioration des Semences d'Alsace" (Alsace Seed Improvement Association and the 'Station Agronomique of Colmar' on the one hand, and the "Association Lorraine des producteurs de semences sélectionnées et améliorées" (Lorraine Association of Producers of Selected and Improved Seeds) on the other. All three provide agriculturists with varieties suitable to the Eastern region which are becoming increasingly popular. The "Coopérative des producteurs de semences de l'arrondissement de Melun" (Co-operation Society of Seed Producers in the neighbourhood of Melun). (Seine and Marne) has for some years been working in connection with a selection farm at Moissy-Cramayel and a sorting station at Verneuil-l'Étang. The "Coopérative de l'Union Centrale des Syndicats agricoles", le Syndicat de triage et de Sélection de Beauce (Beauce Sorting and Selection Syndicate the "Coopérative de production de semences sélectionnées de Seine-et-Oise", the "Union agricole des Cantons de Bourlong et Gravelines" (Nord) are all engaged in similar work. Among the individual exhibits, we should mention the very important collections of the firm Vilmorin-Andrieux, those of the "Syndicat central des Agriculteurs de France" and several others. The "Union agricole" of Guingamp (Côtes du Nord), has made a speciality of seed potatoes, especially those belonging to Breton varieties. The South-West region is represented by several agriculturists who chiefly exhibit the wheats of that district. Very popular forage seeds are shown by the agriculturists of the South-East region. A wide spread effort is being made to encourage the production of the seeds of sugar-beets with a high sugar content. The seeds sent from the Svalof (Sweden) Agricultural Institute, together with the cereals and sugar-beet seeds from the Franco-Belgian Selection Station are interesting foreign contributions to the Fair.

Miscellaneous.

Society for Seed Propagation in Germany. — On February 21, 1922 during the session of the Chamber of Agriculture, a Society was founded for seed propagation in East Prussia; 115 members joined at once. The Society has its Headquarters in the same building as the Chamber of Agriculture for the Province of East Prussia, at Königsberg i. P., Beethovenstrasse 24-26. (*Zeitschrift für Pflanzengruchtung*, December 1922. Vol. VIII, Part 4).

The Crisis of Argentine Wool. — For some years past, Lincoln sheep have been introduced into Argentina with a view to the improvement of mutton production and have been crossed with merinoes which, however, tends to render their wool coarse. Recently, Lincoln wool Nos 4. 5. 6. has no longer been bought by France and Germany as a finer wool is required in those countries.

The Argentine breeders hesitate to reintroduce pure Rambouillet animals for breeding, as meat production is their chief occupation and pays well. Further, the transformation of the existing flocks would be difficult and slow and no guarantee could be given that coarse wools might not again come into favour (LÉRNOUD, *La laine argentine Revue de Zootechnie*. No 15, pp. 510-517, figs. 3. Paris, 1923).

Apple-trees in the State of Minas Geraes (Brazil). — During the last seven years, apple-growing for the market has made great progress in the Commune of Maria do Fô in the State of Minas Geraes, Brazil. On one farm, 20 hectares have been planted with apple-trees 8 m apart, in squares, on land ploughed with a Brabant, or oliveyard plough, type 51x. The first trees were brought from França (State of San Paolo). A liberal supply of manure, tobacco residues, bone-meal, nitrate of soda etc., is applied. As a rule, the spaces between the trees are filled with herbaceous crops, e g., cereals, or kitchen-garden plants, if they are not already occupied by leguminosae.

Of the varieties of apple-tree tested, two, *Winter Banana*, and *American Beauty* both natives of the United States, proved the best. The "Serviço do Fomento agrícola" of the State has supplied technical directions for the management of these plantations as well as for the plum, pear, cherry and other orchards. All the latter species have become thoroughly acclimatised and already bear fruit of great commercial value (*Brazil-ferro-carriil*. Year XIV, Vol XXIV, No 276, p. 52, Rio de Janeiro, 1923).

Telephone Companies for United States Farmers. — (SPASOFF J. M. and BEARDSLEY H. S. (Junior Economists, Bureau of Agricultural Economics. Farmers' Telephone Companies, Organisation, Financing and Management. *U. S. Department of Agriculture Farmers' Bulletin* No 1245, pp. 1-30. Washington, December 1922.

The object of this Bulletin is to provide the information necessary for the extension of the telephone service in rural districts and the improvement of existing telephonic communication. It treats of general questions relating to the organisation, finance and management of rural telephone systems, without, however touching upon the technical part of the subject. It appears that about $\frac{2}{5}$ of the farms in America are already provided with a telephone.

Free Explosives for Land Clearing. — *Farm Implement News*, Vol 43, No 35, p 11, Chicago, August 31, 1922.

The Public Works Department of the United States has placed at the disposal of agriculturists millions of pounds of picric acid for clearing the land and removing tree stumps. On the conclusion of the War 12 000 000 lb. of picric acid remained over, and were distributed among the various States for road-making purposes. There still remain about 5 000 000 lb. to be disposed of. The Agricultural Institute of Minnesota reports that the use of picric

acid has given a great impetus to land-clearing. Last year, the 744 000 lb. of picric acid allocated to the State were distributed among 3511 agriculturists, 222 lb. being given on an average to each. It is estimated that 35 000 acres will be cleared by means of the explosive and that its use has saved 70 000 dollars.

The Value of the Agricultural Machinery on the Farms of the United States. — This census has been made for the different States of the Union. The figures for the whole country are as follows: returns of 1910 census: 1 265 149 783 dollars; returns of 1920 census: 3 594 772 928 dollars. (*Farm Implement News*, Vol. 43, No. 23, p. 17, Chicago, June 8, 1922).

Tractors in California. — According to a report published by the standard Oil Co., there were 21 922 tractors in the State of California on January 1, 1922. An earlier census gave the number as 17 380 on August 1, 1920, therefore it must be concluded that 4 542 tractors were sold between these two dates. The proportion of agricultural farms provided with a tractor slightly exceeds 19 % (*Farm Implement News*, Vol. 43, No. 13, p. 8, Chicago, March 30, 1922).

Contagious Abortion of Cows in France. — The Director of the Sanitary Services of the Ministry of Agriculture of France has requested the departmental veterinaries to conduct a series of experiments in vaccination against contagious abortion in cows. A special staff has been appointed for this purpose at the research laboratory of the Veterinary services. Requests for information and material should be set to the Director of the said laboratory: 1 Chemin du Fort, Alfort (Seine - France) (*Journal d'Agriculture pratique*, Year 86, Vol. II No. 51, Paris, 1922, pp. 509-510).

Field Control Service of Potatoes in France. — A control Service for seed potatoes of different varieties was organised in 1922 by the Central Agricultural Society of Aveyron. All seed potatoes sold through the medium of the Control Service come from fields that have been inspected twice at least during their vegetative period and found to be free from: mosaic disease, leaf-curl, streak, Verticillium, black leg and Rhizoctonia (*La Vie agricole et rurale*), Vol. XXII, No. 5, February 3, Paris, 1923).

Herd-Books in Brittany (France). — Two new Herd-books have just been published in Brittany: 1) the first volume of the Brittany Black Pied Herd-book. The Admission Committee adopts the system of a scale of points, 2) the first volume of the "Race armoricaine" Herdbook. Registration according to a scale of points (*Revue de Zootechnie*, February, 1923).

The Herd-book of the Alsatian Vosges Breed of Cattle, in France has just been started. Registration is based on the Pedigree-book, Show records and filiation. The Pedigree-book will be closed on December 31, 1925 (*Revue de Zootechnie*, February 1923).

French Breeding Office. — On Friday, December 15, 1922, was held in Paris the First General Meeting of the "Office français d'élevage, a Federal Union of the Breed Societies, Studbook and Herdbook Societies and Poultry-breeding Clubs. The composition of the Office Staff the Managing Committee and the Statutes of the Office are given in the *Revue de Zootechnie*, Year II, No. 1, 1923 (Assemblée Générale de l'Office français d'Élevage. *Revue de Zootechnie*, Year II, No. 1, pp. 58-67. Paris, 1923).

An Agricultural Electricity Co-operative Society in France. —

(M. RINGELMANN) The author has obtained from the report of the Société Coopérative Pronies-Rosay-Electric, certain figures which are useful to other societies engaged in the transformation and sale of electric power to agriculturists. Roughly speaking, the receipts of this cooperative society may be apportioned as follows: 75 % from threshing, 12 % from lighting, 10 % from engines and 4 % from grain crushers and potato crushers

Manufacture of Synthetic Ammonia in France. — At the session of February 8, the Chamber of Deputies passed the bill on the manufacture of synthetic ammonia. The bill will at once be laid on the table of the Senate. The consumption of this ammonia is said to amount to at least 400 000 tons per annum of which scarcely 12 00 tons are now produced in France

The adoption of the scheme that will be submitted to the Senate for examination, would make it possible for the National Gunpowder Factory at Toulouse to produce a considerable amount of nitrogen, but the remainder will have to be supplied by private enterprise. In any case, the scheme has now been clearly stated and there is a good prospect of its realisation (*Le Progrès agricole et viticole*, Year 40, No. 8, February 25, 1923)

Tobacco in Algeria. — In a report in the tobacco-growing prize-competition, the Vice-President of the Algerian Chamber of Agriculture stated that excellent results had been obtained in the course of the last few years from the building of cooperative bonded warehouses for tobacco

In 1921, the Chamber of Agriculture decided to grant prizes for improved cultivation and allocated the sum of 4000 fr for that purpose. The report describes the work of the eight competitors who presented themselves (*Journal d'Agriculture Pratique*, January 20, 1923)

The Formation of a Commercial Museum at Tananarive (Madagascar). — The General Government of Madagascar has decided to create a Commercial Museum at Tananarive in order to give local importers the opportunity to sell the type of products made in the mother-country and to supply buyers from French firms with samples of local products. The manufacturers and exporters of France would find it to their interest, with a view to developing their connections with local Madagascar trade, to forward complete and varied stocks of samples. The Government Authorities of the Colony will inform the senders as to the requirements of customers in Madagascar

Wool Production in Madagascar. — An arrangement which has just been made by the President of the Tourcoing Chamber of Commerce shows that, the scheme that this Chamber, in conjunction with the Chambers of Commerce of Roubaix and Mazamet, has striven to promote, will now be carried out. The experiments in merino sheep-breeding in the South of Madagascar will be conducted under the direction of an agricultural expert, placed at the disposal of the Chamber, who will have the assistance of shepherds sent for the purpose, from South Africa and Australia. Acclimatisation experiments, which should also be made in South Africa, will begin next October (*Les cahiers coloniaux. Circulaires de l'Institut colonial de Marseille*, No. 214, February 1, 1923)

Agricultural Committee for the Assistance of the Allies. — At the last general meeting of the Royal British Agricultural Society, the Secretary presented the annual report of the Society. This report included a sum-

mary of the work of the Agricultural Committee for the Assistance of the Allies. The countries which received most assistance during 1922 were Roumania and France. In France, cattle were distributed in 1922 to the value of £18 000, this sum having been given by the British Ambulance Society. The 82nd annual show of the Royal Society will be held this year at Newcastle-on-Tyne from July 3-7

Wool Growing and Marketing in South Africa. — The movement initiated by the Grootfontein School of Agriculture, which has resulted in the formation of a number of Wool-Growers Associations, is expected to do much to enhance the value of South African wool on the Overseas Market. These Associations, according to the Journal of the Department of Agriculture of the Union of South Africa, aim at the careful classification and breeding of sheep so as to improve the standard of wool, and by means of the inspection, sorting and packing of wools by qualified persons ensuring the sale of the wool under circumstances that afford a guarantee of its standard.

ORIGINAL ARTICLES

THE PERIODICITY OF METEOROLOGICAL FACTORS IN RELATION TO AGRICULTURE. (1)

The extension of the network of communication formed by meteorological observation posts, and the multiplication on all sides of records definitely proving the effect of climatic factors on various crops have given rise to a great problem viz., how far it is possible to forecast the weather long enough in advance, in order to know beforehand the variations to which agricultural products will be subjected.

This question arose even before scientists were able to suggest the best apparatus to be used, and at a time when man was forced to rely upon his own direct observation and the traditions handed down to successive generations, which gradually, as time revealed their accuracy, became crystallised into the proverbs current among peasants in general and agriculturists in particular. In most cases, these counsels deal with the agricultural operations necessitated by variations in meteorological phenomena, and are expressed in the form of doggerel verse which renders them easy to remember and spread abroad.

Now, however, that individual observation has been superseded by observations made with the help of instruments that facilitate the recording of many interdependent factors, the great problem of weather-forecasting has again come forward, and the scientists have

(1) In the second number of this Review Sir Daniel Hall has alluded to the wide field for research offered by Agricultural Meteorology, particularly with reference to the periodicity of the chief meteorological phenomena. Much information on this last question has recently become available, thanks to numerous investigators.

subjected the different data to a minute examination with a view to discovering by means of detailed analysis and with the assistance of mathematics what variations are possible and most probable.

Weather forecasts are divided into two classes : short-term and long-term forecasts. We already know the benefits that agriculturists might obtain from the first, if they took more interest in them and thought them worthy of credence. Now-a-days, meteorologists are in the position to render valuable assistance to the farmers and collaborate with them so as to obtain better crops, for the synoptic weather charts, if properly interpreted according to the different localities, make it possible to forecast the weather for some days, or some hours, but always sufficiently early to enable possible injury to the various crops being greatly lessened.

We will now, however, consider another type of forecast which is the most far-reaching for general purposes and should be combined with the first in order to further improve agricultural production. To be able to predict the rainfall of the successive seasons, and the thermic limits of the various phases of growth, would mean a step forward on the road leading to the stage of maximum development that all regard as the ultimate goal of mankind.

The equatorial regions are the parts of the world which are most suited to these investigations, since they are not subject to the frequent and rapid changes of weather that occur in more temperate zones. In the latter, indeed, swift and even instantaneous disturbances arise, which may be compared to barometric depressions and cyclones, as they quickly alter the regular course of the temperature and the rainfall. Unfortunately it is in the temperate regions that man has constructed his greatest works for utilising the forces of nature and hence he suffers and will suffer more there from seasonal variations until perhaps a more careful analysis of the facts, or further scientific progress, reveals the laws that undoubtedly govern these variations.

The system adopted hitherto for making weather forecasts has been essentially based on the statistical examination of meteorological data collected in various places, and many scientists have tried to establish some connection between the variation in the frequency of sunspots and the variations in certain terrestrial meteorological phenomena. At first, the investigations were directed to the temperature of the air, and the form of the curve representing the thermic variations appeared to be just the converse of that of the sunspot

curve, viz., high temperature corresponded to the minimum number of sunspots and *vice-versa*. This correlation proved very regular in the tropics where the difference between the extreme temperatures is as much as 0.5° C., in high latitudes, however, not only is the variation very slight, but there is a tendency to a secondary oscillation shown by peaks on the curve of the equated thermometric values, and in a periodicity similar to that of the semi-period of the sun spots.

HENRY, in his recent examination of many average variations in the temperature of the atmosphere in the United States and in other countries, found that variations of changing importance and duration frequently occur simultaneously over large areas of the earth, and may present opposite characters when one passes from one region to another. The investigations made to ascertain whether these values were repeated in a systematic manner seem to prove that they recur within 3 or 4 years, or in a period one-third of the duration of the sunspots' period. The range of the variations in the average annual temperature, which seem to have some connection with the number of the sunspots, is one degree in the tropics and decreases towards the poles. The temperature reaches its maximum in the equatorial regions towards the time when the largest number of sunspots occur, but there is no complete synchronism between the two variations.

Similar secondary variations were also noticed by BUCHAN in the annual amount of rainfall and by WALLEN in the variations of the water-level of some lakes.

HELLMANN, from a study of the variations in the rainfall returns in different cities arrived at the conclusion that throughout Europe no well-marked connection exists between terrestrial and solar phenomena. Most of the Stations recorded two maximum rainfalls occurring in the eleventh period of the sunspots and at an interval of 5 or 6 years apart. The period of fewest sunspots generally corresponds to that of the lowest rainfall, while the range of the variations in the rainfall during a period of solar activity is very slight and sometimes most uncertain.

LOCKYER, who studied the average annual atmospheric pressure in Australia, discovered a 4 years' period similar to the period he had already found to exist in India and South America, and corresponding to a 4 years' frequency cycle of solar protuberances based on the observations of the Italian astronomers.

KLEIN found cirrus clouds to be most numerous during the maxi-

imum period of sunspots, which may perhaps be explained by the greater precipitation of the water vapour in the atmosphere.

BRUCKNER, who made use, not only of many meteorological observations that had been collected since 1700, but also of indirect proofs of changes in the climate (the traces left by the displacement and retirement of glaciers, the date of the vintage, the opening and closing of navigable channels by the movement of the Polar glaciers, the recurrence of severe winters) succeeded in obtaining data referring to nearly 1000 years. From the examination of this evidence he concludes that the whole earth is subject to climatic variations which are shown as oscillations of cold, damp periods alternating with hot dry periods and form a terrestrial climatic cycle of about 35 years.

BRUCKNER further deduces from these facts that the periods of rainfall are not synchronous throughout the globe, but that oceanic regions exist where the variations are just the opposite to those occurring in the interior of the continents which he terms temporary, or permanent, exceptions. He also noticed that in the oceanic areas, the variations in rainfall were opposite to those found in continental areas so that a certain compensation seemed to exist at all events as regards rainfall between the continents and the ocean.

BRUCKNER also discovered that the curves showing variations in the rainfall and the barometric pressure in Europe have an opposite course. He further found that there was no progressive retardation in the rain periods due to changes of latitude, or longitude. HELLMANN, however, noticed that in passing from southern to northern latitudes the time of the maximum and minimum rainfall became later as the latitude became higher.

CLOUGH has proved still more recently that both in the case of rain and temperature, the annual extremes in higher latitudes occur earlier than in the tropics, the average difference being as much as 5 years.

LOCKYER was of opinion that there is a cycle of about 35 years in the variations of the interval between the minimum of sunspots and the following maximum, while WOLFF from his examination of the figures referring to the sunspots from 1750 to today, reached the conclusion that there is no regular periodicity of the sunspots, and sufficient evidence of the existence of the above mentioned 35 years' cycle is also lacking.

NEWCOMB, on the other hand who takes mathematical data as his basis, considers that there must be a constant period for the sun-

spots, and that the discrepancies existing in the data collected are accidental and depend upon errors in observation. CLOUGH shared this view and clearly proved the existence of a cycle of 35 years in the variations of the solar phenomena. He further demonstrated that BRUCKNER's cycle falls but little later than the eleven years' cycle of the sunspots. This would mean that the duration of BRUCKNER's cycle is not uniform, but may vary from 25 to 45 years, these variations being synchronous with similar variations in the 36 years' duration of the solar cycle. Should this be the case, the uniformity in the periods of the sunspots, which has been taken as a basis of statistical research by many scientists, is non-existent. In fact, BIGELOW has found that in the meteorological phenomena in the United States, there is an oscillation lasting 3 years, and many other observers, such as MAURER, MOORE, KOEPPEN and NORDMANN have mentioned periods of 7 to 8 years' duration in the variations of temperature, pressure and rainfall.

More recently still CLOUGH, from his investigation of the meteorological and hydrometric data for several rivers in different parts of the United States, has discovered the persistence of a 7 years' period from 1790 to 1919. The duration of this period varied systematically between 4 and 5 years during a cycle of about 25 or 30 years. These variations are synchronous with similar variations in the length of the eleven year period of the sunspots. This period of 7 years tends to predominate as the latitude is higher and the 21 to 22 years' period is a multiple of the 7 and 11 year's periods.

A new method of determining meteorological periods was revealed by the work of DOUGLASS. This is founded on the fact that an intimate connection exists between the annual growth-rings, in the trees and the rainfall of any given place, so that the one can be calculated from the other with an approximation of 8 per cent. DOUGLASS selected for his first studies the pines of the forests of Arizona. Later, he measured various trees in different parts of the United States, South and East England, Norway, Sweden, Germany and Austria, thus obtaining data referring to a period of almost 600 years. From the total of these data he discovered an important correlation with the sunspots cycle.

Dating from 1817, the duration of this cycle may be taken as about 11.7 years, but before that time, it showed certain variations, thus for instance, between 1677 and 1700, the predominant period was 12.5 years. The variations in the sunspots' cycle are exactly repro

duced in the annual rings of the trees with a delay of one to three years, which shows a close connection between the two sets of phenomena especially in the damp climates of North-West Europe and in the States of North America. A second harmonic cycle of $5\frac{1}{2}$ years is also predominant. Other very distinct periods last respectively 26 months, 22, 34 and 101 years. In the different regions the variations are not the same, this is especially noticeable in the interior of Scandinavia, where they occur in an opposite manner to that recorded on the coast of Norway.

It should be noted that the diagrams showing the annual rings of trees have a great resemblance to the curves of sunspots, but they do not give the rainfall dates of a locality. This is due to the fact that the average measures of many trees have been used in the construction of the curves, so that all local variations are eliminated, further, the annual rings are affected by other meteorological factors, such as temperature.

TURNER, by subjecting to harmonic analysis the heights of the Nile recorded for 700 years found indications of a period varying from 240 to 260 years. From studying the numerous determinations made by DOUGLASS, he discovered a double periodicity, of which the two components had a period of 303 and of 248 years. The interference cycle of these is 4840 years $= 16 \times 303 = 17 \times 284$, so that DOUGLASS's series of measures is not long enough to separate them. The third harmonic of the two interfering components is clearly marked, being 163 years $= 16 \times 101 = 17 \times 94.5$, so that it can thus be separated. TURNER himself showed the existence of an earthquake period which lasts from 14.842 to 14.849 years.

ALTER discovered that the said period can be calculated from the period of the sunspots. In fact, by multiplying 14.8 by 9 and dividing by 12 (the number of months in the year) we get 11.3, which is the average period of the sunspots for one hundred years. Subsequently, ALTER wished to confirm the existence of this period by the evidence of the amount of rainfall. For this purpose he used data from 42 areas of the United States, considering them under the three separate heads of Eastern, Central and Western. The curve for all three groups were very similar which shows that the variation is not to be attributed to an accident, but to real periodicity.

MARVIN criticises this method on the grounds that the data examined do not apply to the same period, or to a sufficient number of years. From a rapid study of the question made some years ago,

MARVIN is convinced that the greatest and smallest anomalies of the meteorological factors are almost always associated with the various conditions of the general circulation of the atmosphere. The accurate interpretation of these correlations which are probably fundamental, cannot be based on short and incomplete observations in the manner attempted by ALTER.

BROOKS, in treating of secular climatic variation, shows that the whole globe may be divided into two types of climatic areas. A) those directly dependent upon the heat of the sun; B) those where the variations depend upon differences in the circulation of the air (temperate regions, temporary, permanent, cyclonic, subtropical regions). Thus, only in the regions of class A, can there exist any correlation between the meteorological phenomena and the variations in solar radiation.

MELDRUM examined the relation between sunspots and the course of tropical cyclones. Later, POEY, WOLF and SARASORA made investigations of the same kind. Statistical studies were carried out by MERECKI, MAUNDER, LOOMIS, SEKIGUTI and more recently, by HUNTINGTON.

STORMER and DEELEY have treated of the question theoretically. SIN-ITI-KUNITOMI and HIKOTARI TAKO considered the correlation between the variations in the sunspots and the rainfall.

Other scientists have not contented themselves with the study of a single meteorological factor, but have taken into account the effect of nearly all the atmospheric phenomena upon plants, especially those, which like cereals have a particular economic importance. CHAMBER found in India, that food cereals yield heavier crops in years when there is a large number of sunspots. Recently, however, exhaustive researches have been conducted by SIR W. H. BEVERIDGE, who took the prices of wheat in past centuries as a proof of the abundant supply and therefore of the meteorological conditions during the years in question. He first studied the fluctuations in the prices of wheat in Western Europe, beginning from 1550, and took as an index of the price each year the average price calculated for a 31 years' period of which the year under consideration was the centre. On subjecting to harmonical analysis the figures thus obtained, he tried to find what periods ranging from $2\frac{1}{2}$ years to 84 years could be detected and found the chief periods were two in number, one of 5.1 years (found independently by Capt. BRUNT and J. BAXENDELL) and the other of 35.5 years (Bruckner's period). He also deduced 7 other

periods of 5.67 — 9.75 — 12.84 — 15.23 — 19.90 — 54 and 64 years, which he considered as being almost certain ; 4 periods varying in length from 3.41 to 8.05 years, in and finally, 5 periods of 11 years that corresponded in stage and duration to the periods of the number of the sunspots.

Since rainfall is rightly regarded as the meteorological factor that has most effect upon the various vegetative stages of wheat, BEVERIDGE, basing his estimate on the amount of rainfall for the period 1850-1921, considered that 11 of the 13 cycles almost certainly exist, and after following out the relative stages and their duration as given by harmonic analysis, he traced out a synthetic graphic curve. The agreement between the two series of data was so close, that he thought himself justified in coming to the following conclusions.

The cereal harvests of Central and Western Europe have been subjected since the middle of the XIX century to a periodic influence, or a combination of such influences, that tend to produce bad crops at intervals of about 15.3 years. This period, although corresponding to certain physical facts, is not permanent, but is due to the combination at this time of two, or more, shorter cycles. These cycles, which are more permanent than their combination, are $A = 4.374$, $B = 5.11$ and probably $C = 2.74$ and $D = 3.71$ years.

BEVERIDGE is of opinion that this research may throw some light upon the near future. The nearest maximum phase of the 15.3 years cycle will occur in 1923 ; and if the phase is punctual and its effect is marked, the harvests in Europe that year will be generally bad. In the very improbable case that the arithmetic analyses should prove complete and accurate in every detail, 1923 is destined to resemble 1315, the year of the greatest crop failure ever known in European history.

We do not, however, regard this last conclusion of Sir W. H. BEVERIDGE's as well founded, and think he has perhaps over estimated the importance of his work which, although it is of the greatest interest, since it has for its object the economic history of a long period, is unable to give such accurate results as to enable the amount of the harvest in any given year to be estimated. In fact, if we examine the meteorological records for the past months, we find at least as far as Central Europe is concerned, that the rain, the great regulating force of agriculture, already appears to have been distributed in sufficient quantity to insure a good wheat harvest.

Even leaving this factor out of account, the statements made

by BEVERIDGE do not seem to be well-founded. As R. A. FISCHER justly observes, periodicity in harvests must not be regarded as an unfailing proof of periodicity in meteorological phenomena, since it may also depend upon periodicity in economic conditions. In making investigations of this kind it is impossible to foresee the commercial conditions, which may vary from one country to another.

SIMPSON found from his examination of the rainfall data collected during one century in London that the cycle of 35 years is quite insignificant in comparison with the monthly variations. He is of opinion that there must be considerable correlation between sunspots and meteorological phenomena, but since sunspots have no true periodicity, they cannot introduce periodicity in meteorological factors.

SIMPSON is inclined to think that BEVERIDGE may have discovered a certain periodicity in his grain price curve, but doubts the meteorological character of this periodicity which he believes should more rightly be attributed to an economic or biological factor that has affected the harvest in some manner.

Although it is impossible to deny the cogency of SIMPSON's objections, there is no doubt that if these cycles were determined for an extensive region (Central Europe, for instance, as ATNY and JULE suggest) instead of for a single country, the deductions made might have been more in accordance with the facts.

The origin of climatic variations is of a cosmic character, and all students of the subject now think its seat must be in the sun. From many observations made in different parts of the globe, it has been found that at the period of maximum solar activity, there are a large number of sunspots in all the solar latitudes up to 40° north and south of its equator, but when the solar activity afterwards decreases, the sunspots are confined to two constantly narrowing zones in the neighbourhood of the equator. This enormous change, as RICCO justly observes, is explained by the assumption that the spots and other solar phenomena are produced like whirlpools in water and whirlwinds in the atmosphere, viz., in the depths of great currents which circulate in 11 years from the high to the low solar latitudes and back again, transporting with them the centres of the complex phenomena which show themselves in that great star.

The sunspots, being less luminous and hot than the rest of the photosphere, give off only about $\frac{1}{3}$ of the amount of heat that emanates from the photosphere in the centre of the solar disc, hence it is probable that their abundance must produce a diminution in

the light and heat radiated by the sun. The figures obtained for the sunspots by WOLF do not reveal any variations during the cycle of 35 years, but BRÜCKNER expresses his conviction that such changes in the solar phenomena must exist, and that the climatic oscillations on the earth are connected with a solar cycle to be discovered in the future, possibly, by means of the variations in the intensity of the radiation.

More recently, HELLAND-HANSEN and NANSEN from their investigations of the temperature variations in the Atlantic and Indian Oceans, have discovered the existence of a real correlation between the variations in solar activity and meteorological factors. This correlation is greater or less in comparison according to the part of the globe where the observations were made, but the definite laws governing this thermic correlation and its effect upon atmospheric pressure and rainfall have not yet been found.

BROOKS states that a decrease in the number of sunspots is closely connected with a diminution in the total amount of solar radiation. Several years ago, BARTOLI began some researches at Catania on these variations. By means of a series of very accurate calorimetric measures, he sought to determine whether and in what manner, the intensity of solar radiation depends on the number and extension of the spots, faculae and protuberances, *i. e.*, in one word, upon the condition of the surface of the sun. He also tried to determine whether the solar radiation had undergone any changes. Unfortunately, the premature death of the scientist prevented the collection of numerous valuable data which would certainly have prepared our minds for the new conceptions that we have now reached us through the work of ABBOT.

By studying the many determinations of the solar constant made conjointly by FOWLER and ALDRICH for ever 20 years ABBOT found that the so-called, solar constant, or the energy (estimated in calories) which is received per minute by a surface area of 1 cm^2 , at the extreme limit of the earth's atmosphere and serves as a measure of the sun's activity, is not constant. In the different estimates, are found variations, some of short duration (ranging from one or two days to a week) others lasting longer, but all undoubtedly connected with the activity of the sunspots. The average relative value of the period 1902-12 is 1.933 calories, and that of the period 1912-20 is 1.946 calories. The difference between the two values obtained for the solar constant rarely exceeds 10 %, whereas the solar factor

concerned with terrestrial magnetism is subject to variations that may amount to 20 %. Such variations, although small, must have an effect upon the meteorological conditions obtaining on the surface of the globe, but while some observers are of opinion that an increase in temperature results from the greater extension of the sunspots, others, like BIGELOW, believe on the contrary, that the maximum heat in the high region of the atmosphere must cause a maximum number of clouds, and thus provide a screen against heat radiation, with the result that the temperature of the surface of the soil necessarily falls. From the present state of our knowledge of what happens in the sun, we cannot be absolutely certain that an increase in the extension of the sunspots must decrease the temperature on the earth, or that it actually increases it by increasing the amount of radiation. The fact that these spots are accompanied by very brilliant faculae and great eruptions of gas and enormously heated vapours forming protuberances, as well as the correspondence that exists between the larger number of sunspots and the increased activity of all solar phenomena, lead us to think it probable that a decrease in radiation due to dark spots will certainly be compensated for by the increased physical, chemical and electric energy developed in the star and by more gigantic eruptions that bring to the exterior vast masses of gas heated to very high temperatures and thus rendering available a larger amount of the incalculable potential energy present in the huge mass of the sun.

Such considerations leave us sceptical as to the possibility of applying our knowledge of solar periods to any practical purposes, for though from the examination of the natural integral factors of many phenomena, such as those upon which the researches of BRÜCKNER and DOUGLASS are based, we are forced to admit that the existence of solar periods in the past has been proved, we do not consider that we have any reason to think that they can be relied upon as a basis for predicting the future course of phenomena of still greater importance.

Many quite different factors may interfere with the chief factors, and since they may be due to special, and so far, unknown causes, no definite deduction can be made as to their effect.

Although this line of research demands increasing energy from the new workers that with fresh enthusiasm face the difficulties of scientific enquiry, another wider and more promising field has been opened by the recent dynamic investigations which are now being

carried out by means of the extension of the network of State meteorological posts that have been instrumental in diffusing a knowledge of meteorological distribution which occurs in a manner quite unthought of in the past.

The work of HILDEBRANDSON, RYCKEVORSEL and ARCTOWSKI have revealed a hitherto unknown regulating force that appears to direct the meteorological phenomena in different countries. The particulars of the distribution of barometric pressure throughout the globe have made it possible to distinguish areas where the pressure variations are repeated more or less rapidly than in the neighbouring areas. There are, so-called, centres of activity, or wide and extensive areas of high pressure (anticyclones) or smaller areas of low pressure (cyclones). Both are constantly displacing one another, but anticyclones move slowly and often remain in the same latitudes for many weeks.

Weather changes in temperate zones are chiefly due to the formation and breaking up of these small cyclonic areas, usually called barometric depressions, owing to the small difference between the central and the peripheral isobar. There are some regions where such depressions most readily form, many come from the oceans, while others form in places where a suitable orographical arrangement easily causes the temperature to rise above that in the neighbouring areas. The course of these depressions is now well-known; they pass in a direct line generally from the third to the fourth quadrant, but above them certain forces come into play that affect these centres of activity. In fact, the displacement of anticyclonic areas corresponds with an alteration in the usual course of the depressions and a different distribution of rainfall. These areas of high pressure are slowly displaced, so if their relative position can be determined beforehand, it is possible within broad limits to also forecast further changes in the weather, not indeed the annual amount of the rainfall, which has no direct effect upon the size of the crop, but the distribution of the rain throughout the different parts of the year and during the various growth periods. Even if long series of observations are examined, the succession of meteorological phenomena has, it is true, all the appearance of being fortuitous, and the studies made by DOVE, HELLMANN, BORTOLOTTI, ANGOT, MAURER and the writer of this article demonstrated the impossibility of discovering any periodicity of the meteorological characters of the different seasons.

Now, however, it appears to be possible to forecast seasonal variations in rainfall, as well as in temperature. The system employed is radically different from the old method based essentially on statistical data ; and rests upon a knowledge of the contemporaneous distribution of meteorological factors over a large surface of the globe, for it has been ascertained that a compensation exists between the climatic variations of one region and those of somewhat distant parts of the world.

The many correlation studies made by HAUN, HELLMANN, PETERSEN, EXNER, OKADA, WALKER LYONS and others have proved the increase in the rainfall and the rise in the temperature of some regions to be contemporaneous with a lower rainfall and a fall of temperature in others. There would appear to be an adjustment around certain localities that form the fulcra, as one might say, of the great oscillating action seen in the whole globe.

In the treatise recently published by SHAW the numerous meteorological problems are illustrated in such a way as to assist interpretation of quantitative variations of different agricultural products, especially those of wheat.

Comparative climatology and the present dynamics of climates can certainly reveal the first signs of the successive variations that now manifest themselves to us in a more visible manner in the displacement of the great masses of ice forming the polar ice-caps. Hence, an increase in the network of meteorological posts of observation in the northern regions would enable us better to follow the centres of activity and to reveal the cycles in which they occur, which certainly vary from one region to another. This would undoubtedly bring us nearer to our goal, the solution of the problem of long-term weather forecasting.

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PHENOLOGY AND AGRICULTURE.

Such periodical natural phenomena as are regulated either directly or indirectly by the constant recurrence of cosmic forces acting on them, with special reference to those dependant upon variations of temperature (GANS, p. 357) constitute what is termed the Science of Phenology.

Generally speaking, plants pass through an annual stage of diffusion during which they undergo development in foliage, blossom and fruitage followed by a period of repose. These annual cycles affect the agriculturist, whose labours throughout the year are to a great extent governed by them. For this reason, particular attention is given to such phenomena and for many years past, careful notes have been taken by agricultural scientists of the commencement and duration of such periods of activity. These observations required the initiation of a body of experts whose task it became to endeavour to determine a relationship between certain dates of meteorological importance and those on which the beginning of a period of activity was observed. Among the most energetic pioneers of phenology is to be mentioned Prof. Hermann HOFFMANN, of Giessen (1819-1891). The theory of early phenology was based upon the belief that each individual phase could be made to correspond to the advent of any particular meteorological change and at one time certain phenomena were accepted as facts, merely on account of frequency in occurrence and mass in numbers. It is sufficient to call to mind the tedious investigations undertaken in order to define the limits of vegetation, how, for instance, these limits were thought to be controlled by isothermal lines, regardless of the fact that the developing capacity of any plant is not solely dependant upon climatic forces but also upon its particular pedigree. It is, moreover, doubtful if it were really possible to ascertain whether any species of plant had actually attained the ideal standard of development in its ecological existence.

In studying the theory that climatic influences alone, particularly heat, were responsible for growth, experiments were made in order to determine the mean temperature to which a plant was exposed from a given date to the approximate moment in which it was observed to enter into a phase of development. From the result obtained, this mean temperature was regarded as being constant, irrespective of the time taken to carry out the experiment. (SOLMS LAUBACH). The 1st January was originally taken as the starting point but as soon as it became evident that the duration of the so-called period of inactivity was in no small measure influential over the initial developing stages, this date was altered to the 1st December. (DRUDE, 1890, p. 43). The above methods however, being entirely based on an overrating of a singular factor, namely the absolute degree of temperature in the shade, were rejected by IHNE, KÖPPEN 1871, SCHIMPER 1898, BOS 1906, VAHL 1906, SCHUSTER 1908 and DRUDE 1913 and most energetically opposed by Arnold ENGLER (1905-1913) in respect of their hypothetical laws (GAMS). SOLMS LAUBACH, (1905, p. 60) says " Judging from facts we know, the mean temperature in which the plant thrives during the experimental period is of far less importance than the determination of a series of *consecutive alternating conditions of temperature* adequate to the progress of expansion. For if the mean temperature exercised such a control over the developing phase, then all other outside influences would fall into insignificance in comparison, or else one would have to admit that their effective powers were much inferior to the standard at which we maintain them to be ".

If therefore we are obliged to reject the fundamental principles of early phenology as being unsound, it is evident that very few satisfactory results would be obtained by applying them to practical agriculture. On the other hand, the assiduous observation of facts has brought to light many interesting details. Thus spring-time phenology is intimately associated with the cereal harvest and the certainty of harvest : for instance, in the mountainous areas of central Germany, should the advent of spring be 30 days over due, the cereal harvest will be retarded by about double that time and instead of falling due with more or less clockwork precision sometime between July and August, it will not take place until September, or in extreme cases, in October, when maturing conditions are at their worst owing to cold and damp.

Now if we can conceive the phenology of plants in the sense

given at the beginning of this article and accept it as the doctrine for those recurring phenomena in the vegetable world which are governed either directly or indirectly by cosmic forces: if, moreover, we can completely detach ourselves from the misleading path of mean temperature, modern phenology will assume a different aspect. It will then be clear how with the progress of ecology the science of phenology can gather ever increasing interest and become of real practical importance.

The theoretical fundamental principles of phenology are now totally altered. To-day, the chief problem under discussion among scientists is the origin of those periodical phenomena observed in plant life. Are they the outcome of an essential demand for a change from action to inaction and innate in all animate substance, or are the inactive phases merely attributable to climatic influences occurring annually? Several well-known scientists of latter years prominent among which KLEBS and DRUDE endeavour to throw light on this question by asserting that the origin is to be found in a natural bodily disturbance seeking a sedative in the continual alternation from active to inactive periods regulated, let it be said, by climatic forces.

At this point a question of interest arises as to whether this new phenological problem will allow of a progressive movement in agriculture. In 1922 the author wrote some articles of research which were published in the *Oesterreichische Botanische Zeitschrift* under the title of "Klimarhythmik, Vegetationsrhythmik und Zeitschriftionsrhythmik" (Rhythm in climatic phenomena, vegetation and plant-formation), which should be of paramount interest to agriculturalists in more respects than one. Before enlarging upon these articles, the author would like to mention that by the term "*Klimarhythmik*" is meant the annual course of meteorological phenomena. In addition to the figures of RAUNKIAR (1910), the annexed chart (Fig. 67) shows the climatic conditions prevalent in Central Europe and in the Mediterranean zone. One constant annual period of growth will be observed in Central Europe, while the Mediterranean area is characterized by two distinct vegetative seasons, Spring and Autumn, interrupted alternately by a cold and a dry season. "*Vegetationsrhythmik*" embodies phenomena in the development of individual plants in the course of the year (foliage, blossoming, ripening), while "*Formationsrhythmik*" signifies collective phenomena occurring in the development of a whole group of plant life. In order to

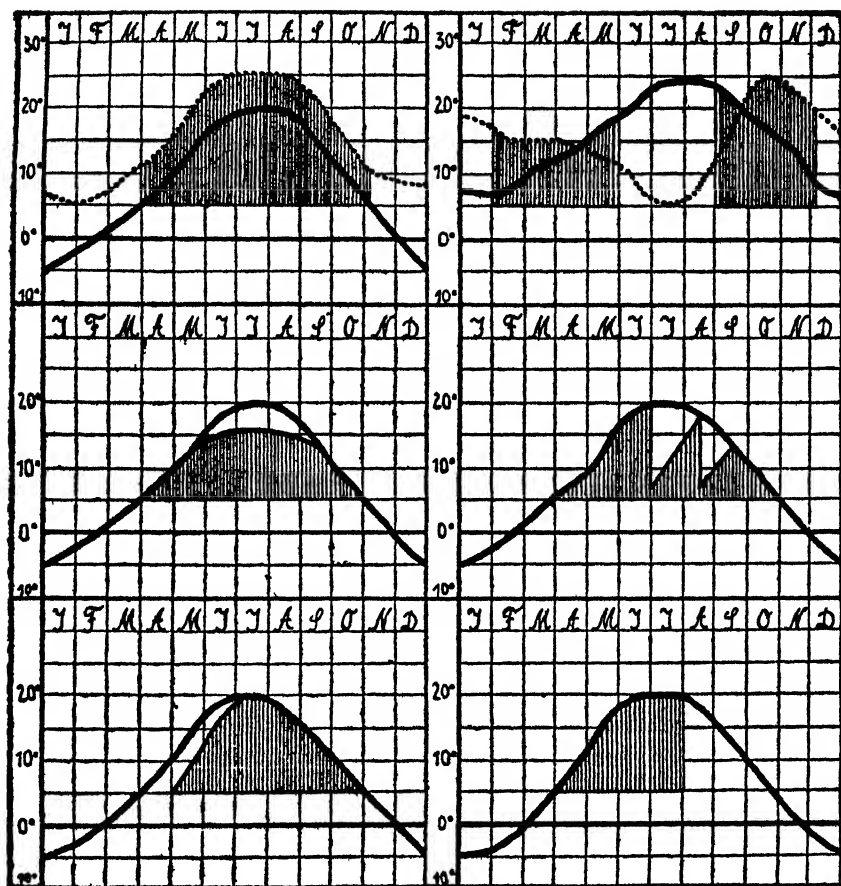


FIG. 67. — Rhythm of Climate and Rhythm of Formation of Central Europe and in Mediterranean Zone.

—— Temperature in degrees Centigrade.
 Rainfall.
 ||||| Period of Growth and Temperature above 5° C.

FIG. 1 (top, left). Rhythm of climate of Central Europe (Graz).

FIG. 2 (top, right). Rhythm of climate in Mediterranean zone (Rome).

FIG. 3 (left, centre). Rhythm of foliage formation.

FIG. 4 (right, centre). Rhythm of meadow-formation.

FIG. 5 (bottom, left). Rhythm of formation of marsh land.

FIG. 6 (bottom, right). Rhythm of field formation.

In Figs 3 to 6 to simplify matters, the course of temperature only is indicated owing to the fact that the temperature and rainfall lines run more or less parallel in Central Europe.

Figs 3 to 6 show that the climatic forces of Central Europe are not utilized to their full extent by the rhythms of foliage (diminution of light, warmth and rainfall in summer), meadow (mowing), moor land (land frozen in spring), and field formation (harvest in August).

(From: SCHARFETTER. *Klimarhythmik, Vegetationsrhythmik und Formationsrhythmik. Oesterreichische botanische Zeitschrift*. Vienna, 1922).

follow the author's meaning as closely as possible these terms will be used throughout the remainder of the article. It will be noticed that phenomena in the expansion of individuals and recurring phenomena in plant-formation, the latter being the result of force created by unity, are in no wise identical. On the contrary the very idea of association in vegetable life will suggest new periodical conditions.

As a theoretical working hypothesis, the ideal state can be visualised when perfect harmony exists between "Vegetationsrhythmik" of individuals on the one hand and "Klimarhythmik" actuating in their particular zone on the other, so that in Central Europe, for example, the general rule would be for the development in foliage to occur in April, the blossoming in May and the ripening season in October. Each species of plant would at least be expected to develop to its utmost capacity in the limited time allowed. Facts, however, prove that the succession of developing phases in the vegetable world on the ideal Central European lines described above is but seldom achieved. As a typical illustration of this point, let us refer to the most important products of agriculture, grain crops, as represented by wheat and rye. These cereals do not take full advantage of the developing season peculiar to Central Europe. Wheat sown for instance in summer begins to germinate in March, flourishes in May and ripens early in August. Now it may be observed that already at the end of July it shows all those symptoms which are common to other typical Central European plants in October only, viz. change in colour and desiccation of foliage, ripening of fruit. The ecological causes of these early phenomena are difficult to understand. Heat and moisture are sufficiently abundant to ensure an ever-increasing supply of nutritive matter essential to the growth of the plant yet, in spite of this, it is a fact that *almost one third of the total "Klimarhythmik" is never used up*. It would require too much time and space to go more deeply into the explanation of this phenomena, suffice it to say that wheat can only be cultivated with the most satisfactory results in districts which have a drought in August. True harmony between "Vegetationsrhythmik" in wheat and "Klimarhythmik" can therefore only be found in such districts, namely in Persia and Syria. It is perhaps unwise to expose a plant *capable* of being cultivated partly inside and partly outside of the vegetation radius (autumn wheat) as an example of species in which the "Vegetationsrhythmik" does not blend with the "Klimarhythmik" of Central Europe and no doubt *Colchicum autumnale*, *Leucojum vernum* and

similar types would be more appropriate and would avoid criticism. It was the author's intention, however, to keep within the sphere of cereals, inasmuch as the above mentioned conditions are not altogether wrong. Moreover the phenomena is of much interest and an opportunity will present itself further on to deal with the question of "Formationsrhythmik" and its relation to the soil.

In diametrical contrast to the "Klimarhythmik" of Central Europe is that prevailing in countries in the Mediterranean zone, characterized by two distinct breaks in the vegetative period. It is of fundamental importance to our theory that species known as *Colchicum autumnale*, true to its hereditary "Klimarhythmik", retains the double Spring and Autumn phase in its Central European "Vegetationsrhythmik".

From the preceding examples we get the following axiom *When the course of "Vegetationsrhythmik" runs parallel to "Klimarhythmik", the plant can be classed as indigenous to that particular region. On the other hand, should there be a divergence in the paths of "Vegetations-" and "Klimarhythmik", then it is probable that the plant is of exotic extraction and conclusions regarding the nature of its native soil can then be drawn through the study of its "Vegetationsrhythmik".*

In opposition to the examples hitherto selected to demonstrate the co-operation between "Vegetationsrhythmik" and "Klimarhythmik" in certain typical cases, our attention is drawn with considerable interest to the question of independent action on the part of recurring climatic forces and phenomena observed in vegetable life. As a large proportion of plants are cultivated on other than native soil, a study of the "Vegetationsrhythmik" of the plant along phenological lines and the "Klimarhythmik" actuating both in its native country and its new surroundings will suggest greater possibilities of cultivation which should be of considerable importance to practical agriculture. The possibilities of cultivation of an exotic plant in new territory depends upon its attitude towards the "Klimarhythmik" of this territory. The hereditary "Vegetationsrhythmik" in any species will be recognised as soon as its origin is determined. In this connection there are three possibilities:

- 1) The "Vegetationsrhythmik" of the plant in the new region is influenced by a "Klimarhythmik" analogous to the "Klimarhythmik" of its native territory. The habits of the plant in this case undergo no significant alteration and cultivation will present few difficulties if any. A good example is to be found in

Indian corn (*Zea Mays*) indigenous to America, for the simple reason that this cereal adapts itself perfectly to the "Vegetationsrhythmik" of Central Europe already described and unlike wheat and rye makes full use of the time allotted to it to incorporate nutritious matter. *Solanum tuberosum* (Sweet potatoes) and *Nicotiana tabacum* (tobacco) may also be mentioned in this connection. Just to illustrate how beneficial Central European "Klimarhythmik" can be to innumerable American plants (and here by "Klimarhythmik" is meant not only the duration of the developing period, the degree of temperature and rainfall, but more especially the rhythmic succession of climatic phenomena) allusion may be made to the exuberant growth of countless weeds, such as *Galinsoga parviflora* and *Erigeron canadense* and the huge masses of such species as *Solidago* and *Oenothera biennis* which cover railway embankments and river-dykes.

2) The new species adapts itself to the new "Klimarhythmik" without any alteration in its "Vegetationsrhythmik". As has already been pointed out, wheat, in the course of its growth does not necessarily require the full co-operation of Central European climatic forces and therefore in mentioning *Colchicum autumnale* we shall find a far more appropriate example of the case under examination. Corresponding to the "Klimarhythmik" of the native country, the "Vegetationsrhythmik" is divided into two sections: thus the blossoming period is in the Autumn while the ripening season or harvest takes place in the Spring. There is no question of accord between the "Vegetationsrhythmik" and the new "Klimarhythmik" (acclimatisation) but rather of a faculty possessed by the plant to adapt itself to altered circumstances. This faculty is shared not only by a large number of weeds, among which *Papaver rhoeas*, *Agrostemma githago*, *Centaurea cyanus* and others which were introduced into Central Europe together with various kinds of cereals, but also by many Spring plants, which profiting, by the period of light penetration through the foliage of Central European woods are observed in the following order: *Galanthus*, *Leucojum*, *Scilla bifolia*, etc.

3) The newly introduced species yields its "Vegetationsrhythmik" to the new "Klimarhythmik". The change wrought under these circumstances can in the first place consist only in the displacement of individual phases of development. This will apply to all classes of product in which the rhythm is not strongly defined. According to the climatic conditions of various countries into which a

certain kind of plant is being introduced, so the change in the "Vegetationsrhythmik" of that plant can operate in different ways. In support of this statement the American *Robinia pseudoacacia* develops in foliage and blossom at one and the same period in Central Europe, while the same species in Southern Italy will develop first of all in blossom and then form its leaf. (KERNER 1890, I, p. 525). This is probably due to a modification of climate in the former case and a necessity of adaptability to circumstances in the latter. The practice of cultivating wheat and rye in Central Europe appears in a new light. Mention has already been made in the case of *Colchicum* of a spring and autumn phase occurring in the "Klimarhythmik" and consequently in the "Vegetationsrhythmik" of individual plants cultivated in Mediterranean regions. The object in sowing wheat in the autumn is to prolong the developing period and the reason why in Central Europe few difficulties are experienced in cultivating cereals of southern origin, can be explained by the fact that the very extension of this period acts as a stimulant to their natural native tendencies. Curiously enough, this extension is not the outcome of an attempt to cultivate a particular race of cereal capable of ripening at a later season than the end of July but is obtained through leaving or rather allowing a part of the work to be accomplished in the preceding autumn.

What in the case of wheat and rye has been achieved through more or less intentional cultivation has come in a natural way to agricultural weeds, such as *Centaurea cyanus*. This plant is both annual and biennial.

The most important consideration for us is the period of inactivity: If the plant begins to germinate in the spring, it will continue its course of development without interruption until the seed is ripe; should germination take place in the foregoing year, then a period of repose, not however, essential to further development, will set in. (WIESNER 1902, p. 81).

Among the common cereals grown in Central Europe, oats (*Avena sativa*) prior to some ten years ago was merely a summer crop. It was only in 1913, after lengthy experiments in selection and cultivation that the "Oekonomierat" HÜGGELMEYER succeeded in cultivating a winter variety of oats even when yet partly susceptible to the rigours of winter. HÜGGELMEYER maintains that the winter crop, in its capacity of producing not only an abundance of grain but also a good quality of straw is of significant agricultural

value. Its early maturing properties enable the field to be cleared earlier than usual preparatory to an after crop (KLER). In addition to this it is a natural enemy of all noxious growth and a participator in the campaign against the troublesome hedge-mustard, closely covering the fields as it does early in the year.

Here let us stop to consider an extremely interesting theoretical problem. The agriculturalist is endeavouring to infect the oats with a "Vegetationsrhythmik" answering to the qualities of "Klima-rhythmik" in Mediterranean areas. To us, the reason why such a stubborn resistance to such attempts is displayed by this cereal is comprehensible. Our own theory for the cultivation of winter oats would be the following: start first of all by acclimatising the oats in the Mediterranean areas already referred to, after which transplant them to Central Europe. Various experiments with plants of different seed origin give signs of good results.

A question which now awaits consideration is the following: To what extent are the periodical phases of development able to be regulated? Even though plants of agricultural value have not been selected for experimental purposes, the experiments carried out by DIELS are worthy of comment. DIELS (1917) cultivated various kinds of summer woodland plants in hothouses, during which he observed that the various stages of growth underwent curious changes. With the species known as *Asperula*, it has been discovered that the period of repose can be totally eliminated, while the same period, usually from 8 to 9 months under natural conditions can be shortened to from 2—2 ½ months under artificial heating in respect of *Leucojum*. On the other hand *Polygonatum* can seldom dispense with the inactive season. DIELS does not hesitate to tell us the conclusions he draws from his experiment respecting plant geography. Thus *Asperula* belongs to a family essentially tropical in regard to its developing characteristics. *Leucojum* is regarded genetically as a Mediterranean plant which has preserved its native characteristics during diffusion, all the more so as the plant, true to its native habits, can be made to counteract the resting phase by artificial means, viz. raising of the inactive temperature. *Polygonatum* on the other hand adheres to the inactive period, thereby proving its alliance to a race of plants indigenous to arctic regions, both genetically and in regard to its developing requirements.

Our theory therefore admits from the first the possibility of acclimatisation. It does not, however, always happen that species

of plant life actually do *alter* their "Vegetationsrhythmik" in order to fall in with some "Klimarhythmik" other than their own. In many cases only certain elements in "Klima-" and "Vegetationsrhythmik" which mutually agree, combine. When such cases prevail, a comparison between phenology of the species and the "Klimarhythmik" of the foreign area should be drawn and the relation of the one to the other carefully studied in order to ensure satisfactory results.

We are now in a position to determine, from various suggestions made, which are the species susceptible to adaptability, that is, capable of changing their "Vegetationsrhythmik", and which are not. The author's endeavour in the foregoing paragraphs has been to point out that plants, the origin of which can be traced to regions which have undergone no climatic change for a geological age (Tertiary) possess an inherent "Vegetationsrhythmik" out of which they can be drawn only with difficulty. This is the reason why North-American types display greater tenacity to "Vegetationsrhythmik" compared with Central European types, in which the "Vegetationsrhythmik", owing to changes of climate which have taken place in Central Europe since the Ice Age, is faintly stamped and is therefore comparatively easy to dislodge.

It would be erroneous to imagine that "Klimarhythmik" is the sole factor to be taken into account in plant-formations and particularly agricultural plant-formations. Neither foliage nor moor, field nor meadow in Central Europe would permit a complete state of harmony to exist between "Vegetationsrhythmik" of individual plants and "Klimarhythmik" peculiar to the country. The existence of plants in common, in the light of cultivation, tends to create new conditions, which are of even greater importance than climatic conditions. Let us pass over the Central European formations in respect of foliage and moor and turn our attention briefly to the conditions prevailing in field and meadow.

The mowing of *meadows* causes a check to the normal course of Central European "Klimarhythmik" besides a splitting up of the vegetating season, short as it is, which WERTSTEIN (1904) distinguishes as first low level, first high level, second low level, second high level and third low level. It is not difficult to explain how plants which have thriven under foreign "Klimarhythmik" and formed therefrom a corresponding "Vegetationsrhythmik" are eligible for classification among these plant-formations. *Scilla*, *Leucojum*, *Gagea* and *Colchicum* are species whose native environment lies in the

Mediterranean zone, while, according to GRADMANN, *Salvia pratensis*, *Coronilla varia*, *Dianthus carthusianorum* are types belonging to the variety of Southern European Steppe plant. Reference is once more made to the fact that comparatively few species have adapted themselves to conditions of growth in the meadows, i. e. have changed their "Vegetationsrhythmik" to enable them to live in them; the "Vegetationsrhythmik" of the majority has been sufficiently adequate to the demands of "Formationsrhythmik".

It has already been remarked that the sudden shortening of the vegetation period of plant life in meadows by unnatural causes, the cycle of development in the *fields*, as also in the cultivated Steppe regions has already run its course by the end of July, owing to adhesion on the part of the plants to "Steppenrhythmik".

The scythe brings the life of plants with Central European "Vegetationsrhythmik" to an untimely end, thus leaving the fields clear for the growth of weeds of South-Eastern European and Pontic extraction. Among the former are classed. *Adonis flammea*, *Asperula arvensis*, *Lepidium draba*, *Muscari comosum* etc., while: *Gagea arvensis*, *Galeopsis pubescens*, *Neslea paniculata*, etc., belong to the latter. Weeds of Mediterranean origin are *Agrostemma githago*, *Delphinium consolida*, *Papaver rhoeas*, etc.

It can be seen merely from the few examples mentioned in this article, what a vast variety of problems Phenology is capable of presenting, that is, if we regard this science in its true light, namely as the study of periodical development in plants in conjunction with annual climatic phenomena. The science of Phenology promises many important discoveries in connection with possibilities in foreign plant cultivation and holds the key to the origin of innumerable varieties of plant life which abound in our fields and meadows.

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THE STATUS OF THE MOVEMENT TO ESTABLISH UNIVERSAL STANDARDS FOR AMERICAN COTTON. (1)

INTRODUCTION.

In the closing days of the last session of the 67th Congress of the United States, the United States Cotton Standards Act, a measure that has been under discussion to a greater or less extent since 1914 was passed. Because of the extended discussions in previous years and the fact that the cotton trade of the United States had been fully consulted, renewed hearings upon the measure were not called for. No opposition of any moment developed in either house of Congress. This law establishes national standards for cotton in the United States. The purpose of this article is to point out the advantages which would accrue to producers, the trade and the public generally, by the adoption of Universal Standards for American Cotton.

FUNDAMENTAL PRINCIPLES.

Before discussing the advantages of the adoption of universal standards for agricultural products in general and cotton in particular, it is perhaps well to state a few axiomatic principles which have an intimate bearing upon the economics of standardization.

1) The price of a particular unit of an agricultural commodity depends in a large measure upon two factors · (a) quantity, and (b) quality.

2) The commercial world has adopted measurements of quantity which are definitely known and are in units which may be

(1) The author gratefully acknowledges the helpful collaboration of Mr. W. R. Meadows, Chief of the Cotton Section of the Bureau of Agricultural Economics, U. S. Department of Agriculture, and his assistant, Mr. A. W. Palmer, in the preparation of this article

readily expressed with mathematical exactness in terms of the units of each of the several countries. For example, one country may use the pound as a unit of measurement for a given commodity, while another country designates quantity of the same commodity in terms of kilograms. Nevertheless, the relationship between these units is invariable and one may readily be expressed in the equivalent of the other.

3) Without definite measurements of quality or without measurements which can readily be translated into the equivalents in use in the several countries, there can be little comparison of value. In other words there can be no uniformity in price statistics unless there be a method of comparing measurements of quality as well as measurements of quantity. Quality is one of the inseparable factors of the prices of an agricultural product.

4) The lack of a common language for describing and expressing quality of specific farm products gives rise to endless disputes, costly delays and expensive arbitration proceedings. Universal Standards tend to reduce the possibility of misunderstandings arising over quality.

5) Standardization may be defined as a means of formulating a common and definite language for the measurement of quality.

6) Universal standards require the adoption of a closely supervised system of impartial inspection. Since quality is so intimately connected with price, it is essential that the inspection of grades be not influenced by the special interests of either buyers or sellers.

7) Universal standards also presuppose a neutral system of arbitration for the settlement of disputes over quality. Such a system of arbitration necessitates machinery whereby the interests of buyer and seller are equally represented.

It is assumed that the above seven statements will be accepted without controversy as approximate economic truths.

ADVANTAGES OF UNIVERSAL STANDARDS FOR COTTON.

The desirability for uniform cotton standards as applied to cotton trading in the United States and in fact to trading in American cotton throughout the world, has never been questioned by any well informed part of the cotton industry and trade, from producer to spinner. When it is borne in mind that under former prevailing conditions a wide variety of standards were in use so that

cotton called " Middling " in one market was not middling in another, and that this situation was used to confuse the shipper and in some cases even to defraud him, it is clearly apparent that a single standard applied by a disinterested agency would be of great assistance to the industry.

The desirability of attaining uniform production of the required qualities of cotton in all of the cotton growing states is very apparent. The existence and use of a single standard by which judgment may be guided will tend very greatly to the production of varieties furnishing uniform staple and character. The application of a single standard will also do away with unfair price discriminations, as the grower can now be taught what constitutes the quality and character that gives value which will be the same for long periods, until fundamental conditions in the industry make alterations necessary which in the nature of the case would be slight, in any standard that may be established from time to time

In the organization of every manufacturing plant in the civilized world, the necessity for economy and efficiency in its processes of operation is so thoroughly understood that it has long been a fundamental consideration. To those who today are giving thoughtful attention to the rebuilding of industry and the re-establishment of normal economic conditions, there appears first of all the need for fresh surveys of all present-day methods of industrial practice to the end that the points where waste and loss occur, that heretofore have escaped notice, may be located and corrective measures taken.

Not only must new economies be devised and applied in the sphere of manufacturing, but the same principles must be followed with equal steadfastness in the field of merchandising. It must be recognized that every extravagance and needless expense in the processes of trade, operate as a tax upon the economic well-being of the world in general and upon the prosperity of those directly interested in particular.

To those familiar with the raw cotton trade in its international phases, faults in the present methods of dealing are very generally and at the same time, very definitely realized. In Liverpool and on the Continent there exists a nomenclature for cotton classification similar to that employed in America, but of which the meaning is markedly different. Under these conditions, it becomes very difficult for the average dealer to make intelligent comparisons of quotations in American and European markets or to form ideas of cotton

values on anything approaching a common basis. As a direct result of these conditions, the sale of cotton by America to Europe is attended with frequent misunderstandings and disputes which at best have usually to be settled by arbitration. Disputes and arbitrations are a form of waste and extravagance that can and should be reduced to the lowest possible minimum. Under existing arrangements, arbitrations are necessarily conducted in widely separated places and by agencies variously constituted, among which there is little community of ideas and no fixed standard of value. The decision of any arbitration committee of to-day is, therefore, of little use to the trade at large, beyond the settlement of the immediate dispute and contributes absolutely nothing to the ultimate solution of the problem of making satisfactory shipments in the first instance.

In the domestic Commerce of the United States, experience has fully demonstrated that disputes can be materially lessened by the adoption of a uniform nomenclature of cotton grades in all the principal markets and by the establishment of uniform and acceptable representations of these grades distributed throughout the country and employed by the trade as a basis on which to conduct its business. Not only are complaints lessened in number by the use of standards, but the adjustment of such disputes as require settlement by arbitration is measurably simplified and facilitated and accomplished with greater satisfaction to the parties at interest.

Having in mind the benefits which have attended the use of standards for cotton grades in the American markets, it seems reasonable to suggest that there is opportunity to effect still greater economies and benefits in international trade by the adoption of uniform standards of grade and staple for American cotton.

It is interesting to note that universal standards of agricultural products are in line with the general tendency of international business procedures. At the recent meeting in Rome of the International Chamber of Commerce, much attention was given to such questions as the use of uniform bills of lading, uniform bills of exchange, and the advocating of uniform custom methods. It is also interesting to note that the International Chamber of Commerce has established an International Board of Arbitration, and that the Chamber strongly urges its members to insert the uniform "arbitration clause" in their contracts covering international transactions.

A BRIEF HISTORY OF THE MOVEMENT TO SECURE UNIVERSAL COTTON STANDARDS.

Since the American view is based upon American experience in the domestic handling of its greatest export commodity, it may be of interest to trace somewhat in outline the steps leading to the promulgation of standards in the United States and to point out the success that has attended their use in order to explain more fully the present situation and to make clear the position of the American trade and the U. S. Department of Agriculture with respect to it.

Cotton classification originated in Liverpool (1). The earliest known reference to the term "middling" is found in the Liverpool Cotton Brokers' Circular for the year 1801. In 1808 Maury's Price Current classified Sea Island cotton into "fine", "good", "middling" and "ordinary and stained", but referred to Upland cotton only under the names of the countries producing it. In 1833 grade names were used in a loose way for Upland cotton by brokers in the Liverpool market. For instance, New Orleans cotton was quoted under the three designations, "very ordinary to fair", "good fair to good", and "very good to prime".

On June 10, 1874, representatives of American cotton exchanges met in Augusta, Georgia, and, as their most important item of business considered the adoption of a uniform standard of classification of cotton for the United States. A committee was appointed which recommended to the convention the adoption of a "Standard American Classification". This recommendation resulted in the selection of a committee of experts, who agreed on standards which were forwarded to the cotton exchanges of this country. The Standard American Classification was used by most of the exchanges during the season 1874-75 and a part of the following seasons, but in the course of a few years it was discontinued by practically all except the New York Cotton Exchange.

Following the dissolution of the loose association of several cotton exchanges, known as the American Cotton Exchange, and the discontinuance by practically all the leading cotton markets of the Standard American Classification, great diversity developed in the

(1) DE LEACH, R. J. H., History of Cotton Classification. In *Transactions of the National Association of Cotton Manufacturers*, Annual Meeting April 24-25, 1912. No. 92, p. 316.

use of standards. Some markets adopted the Liverpool standards, while other markets adopted as the basis grade of their standards the "fully middling" or the "good middling" of the Liverpool Standard. Some markets established standards based upon, or bearing a direct relation to, the Standard American Classification which was still in use in New York, while other markets created standards entirely their own. Although using identical grade names, no definite relation existed between various standards in use in the cotton belt, and quotations for a specified grade of cotton soon became confused and meaningless unless the standard of a particular market was designated. Even this was not always adequate, as some markets claimed the right of varying the standards from year to year to meet the exigencies of the crop. Thus a standard became a variable measure of quality, and quotations based thereon were confusing and often misleading.

ACTION OF INTERNATIONAL COTTON CONGRESS

In 1907 the International Cotton Congress, which was composed of cotton growers, spinners, and manufacturers from both Europe and America, at its annual meeting held in Atlanta, Georgia, unanimously passed a resolution favoring the adoption, either by the Government of the United States or by an association composed of representatives of cotton exchanges, cotton growers, and cotton spinners, of standard types for grade and color.

In 1909 Congress authorized the Secretary of Agriculture to establish a standard for nine specified grades of cotton. These were established, their use being entirely permissive.

Between 1833 and 1913 there had grown up in the Liverpool Cotton Association the use of three sets of standards, the exact origin of which is not definitely known. They represented Upland, Gulf and Texas cotton. They seem to have resulted from a process of evolution caused by the increasing necessities of the cotton trade, being built up by the preparation, from time to time, of single types and boxes and not by the adoption of a complete set of standards at any one time. These have always been known as the Liverpool Standards.

In June, 1913, representatives of the Liverpool, Havre, and Bremen exchanges, of the leading American exchanges, and of spinners associations, met in Liverpool. During this conference the so-call-

ed International Standards, which were a modification of the pre-existing Liverpool Standards for Upland cotton, were agreed upon. They were later accepted by the Liverpool Cotton Association as the Liverpool Standards for Upland cotton, and by the Bremen and Havre exchanges, their use being made effective September 1, 1914. Liverpool, however, continued the use of its existing standards for Gulf and Texas cottons. In respect to the distinction between Upland, Gulf, and Texas cottons, there seems to have been a difference of understanding as to the comprehensiveness of the so-called International Standards. Many American merchants apparently understand the International Standards as covering the three growths of cotton, while the foreign exchanges recognized them as applicable only to Upland cotton.

It may be stated that the Liverpool terms "Upland", "Gulf", and "Texas", were formerly more significant of character than they are to day, but with the wider distribution in the American cotton belt of pure seed of single superior varieties, the more extensive adoption of improved methods of culture and handling, coupled with improved facilities for transportation, these old terms have lost most of their significance. Their continued use and acceptance by the European trade is fraught with temptation to deception, cotton frequently being shipped from one section to another so as to enter into the more favored classification. For several years the term "Upland" in the United States has been applied quite generally to all growths of American cotton except, of course, the Sea Island and American-Egyptian varieties, and the American standards for Upland cotton comprehend all growths of such cotton; each type box of such cotton contains samples from all sections of the cotton belt.

ACTION OF REPRESENTATIVES OF AMERICAN EXCHANGES.

On October 27, 1913, representatives of various cotton exchanges in the United States met with the Secretary of Agriculture in Washington, D. C. and urged the adoption by the Department of the so-called International Standards. In May, 1914, a convention, representing nearly all of the cotton exchanges of this country, which assembled at Augusta, Georgia, passed a resolution recommending the acceptance and use of Government standards by all American exchanges and asked the Department of Agriculture, which was entrusted with the preparation and issue of standards, to adopt the International Standards.

THE OFFICIAL COTTON STANDARDS OF THE UNITED STATES.

The United States cotton futures Act of 1914 authorized the Secretary of Agriculture to establish and promulgate standards of cotton by which its quality or value may be judged or determined, including its grade, length of staple, strength of staple, color, and such other qualities, properties, and conditions as may be standardized in practical form, to be known as the "Official Cotton Standards of the United States". The use of the standards established under this act was made practically compulsory on the cotton future exchanges in the United States on and after February 18, 1915.

In preparing standards for grade under the United States cotton futures Act the primary object was to secure comprehensive standards for cotton of American growth which be adapted to the needs of the trade in the United States and at the same time might be suitable for adoption as international or universal standards for American cotton. These standards are therefore almost directly applicable for use under the new law, the Cotton Standards Act.

Cotton experts from New York and New Orleans cotton exchanges were secured to assist the experts in the Department of Agriculture in preparing the new standards. As bases in this work they used the permissive official standards and the so-called International or Liverpool Upland Standards.

VISIT OF REPRESENTATIVES OF THE UNITED STATES DEPARTMENT OF AGRICULTURE TO LIVERPOOL, BREMEN, AND HAVRE, IN 1914-1915.

Prior to the actual promulgation of the official standards provide for in the United States cotton futures Act, cotton specialists went to Liverpool, Bremen, and Havre as official representatives of the Department of Agriculture, for the purpose of explaining the proposed standards for grade and of urging their adoption by the Liverpool Cotton Association, by the Bremen Baumwollbörse, and by the Syndicat du Commerce des Cotons du Havre. The advantages of an agreement at that time by the Liverpool Cotton Association on a uniform standard for international dealings in American cotton were urged in detail.

On November 16, 1914, a special committee of the Liverpool Cotton Association adopted a motion endorsing a single standard

PLATE XVIII

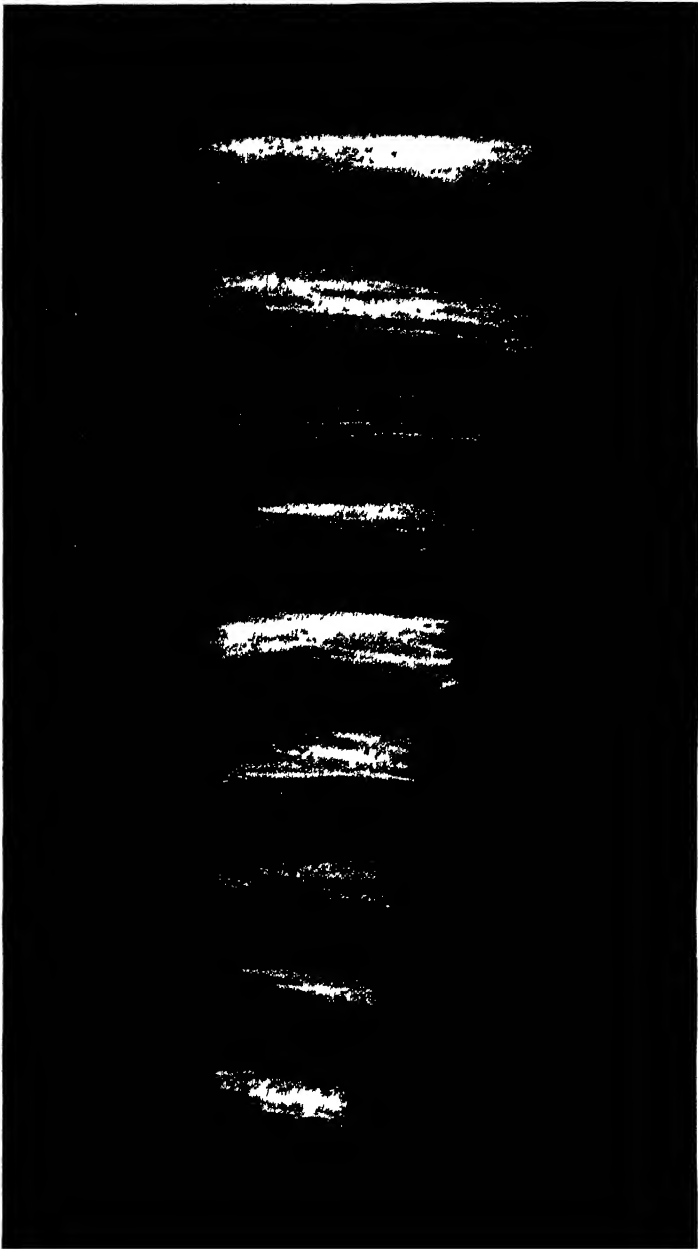


FIG. 65. A Photographic representation of the Official Cotton Standards of the United States of these lengths of staple for which types are available for distribution each respective length is shown being obtained from the original type bale.

Note. Since this photograph was taken types have been prepared for the lengths $1\frac{1}{16}$ and $1\frac{5}{16}$ inches which are also available for distribution.



FIG. 69 — Placing cotton spindles in vacuum under supervision of technical laboratory

for Upland, Gulf and Texas growths of American Cotton. On November 25, 1914, a committee from the board of managers of the Liverpool Cotton Association informed the representatives of the United States Department of Agriculture that the appeal committee had reported unanimously in favor of the proposed Official Cotton Standards of the United States; that these standards had been unanimously approved by the special committee and had been twice approved by the board of managers; and that, therefore, they stood approved by the Association.

At Bremen, the President of the Bremen Cotton Exchange stated that from the point of view of the Bremen Exchanges, it was desirable that they change their standards from those that had formerly been in use and the President saw no reason why his Exchange should not adopt the proposed standards.

At Havre, the proposed Official Standards were displayed and careful comparisons were made with existing standards in use in Havre. At the conclusion of the conferences, the members participating stated that no criticism of the proposed standards could be made.

WORLD COTTON CONFERENCE AT NEW ORLEANS IN OCTOBER 1919 AND AT LIVERPOOL IN JUNE 1921.

The New Orleans Conference put itself on record as favoring the adoption and use of a uniform system of classification for American cotton. The World's Cotton Conference of 1921 at Liverpool adopted the following resolutions: "Resolved, that the World's Cotton Conference recommends and will to everything within its powers to facilitate the establishment of uniform standards of classification of American Cotton".

VISITS IN 1921 TO MILAN, ITALY, AND BREMEN, GERMANY.

Following the World's Cotton Conference, the representatives of the United States Department of Agriculture, together with official representatives of the American Cotton trade, visited Milan, Italy, and Bremen, Germany, and discussed with members of the trade organizations at those places the general object of uniform standards. The cotton trade organizations at these two important places officially indicated their approval of the object sought to be accom-

plished and that they would be inclined to take favorable action as soon as circumstances would permit.

During the months of March and April 1922 the writer visited the principal cotton markets of Europe in the interest of Universal Standards for American Cotton. His efforts met with encouraging results.

As recently as April of this year, the International Federation of Master Cotton Spinners unanimously passed the following resolution: "In the opinion of the International Committee the establishment of Universal Cotton Standards would be to the advantage of the Cotton Industry".

WHAT THE NEW UNITED STATES COTTON STANDARD LAW REQUIRES.

The following brief description of the United States Cotton Standards Act will convey the essential features of the law. It compels every cotton merchant, shipper, buyer and trader in the United States in every transaction or shipment in interstate or foreign commerce, and in every publication of prices, and in quotations of cotton for shipment in interstate and foreign commerce and in the classification of all cotton, to use the official cotton standards of the United States, provided the quality of the cotton involved in the transactions is of, or within the range of, the official cotton standards of the United States.

When the Act becomes effective, bills of lading, warehouse certificates, shipping documents, insurance contracts, newspaper and private quotations of cotton by grade, invoices and all other documents will be required to be stated in accordance with official cotton standards.

The Act further provides in Section 2 that nothing therein shall prevent transactions otherwise lawful by actual sample or on the basis of a private type which is used in good faith and not as a means of evasion of or substitution for the official standards.

Any person who has the custody of, or a financial interest in any cotton, may when the Act comes into full force submit the same or samples thereof, which must be drawn in accordance with the regulations and safeguards imposed by the Secretary of Agriculture, to such officer or officers as the Secretary may designate for a true determination of the classification. The final certificate of the De-

PLATE XX

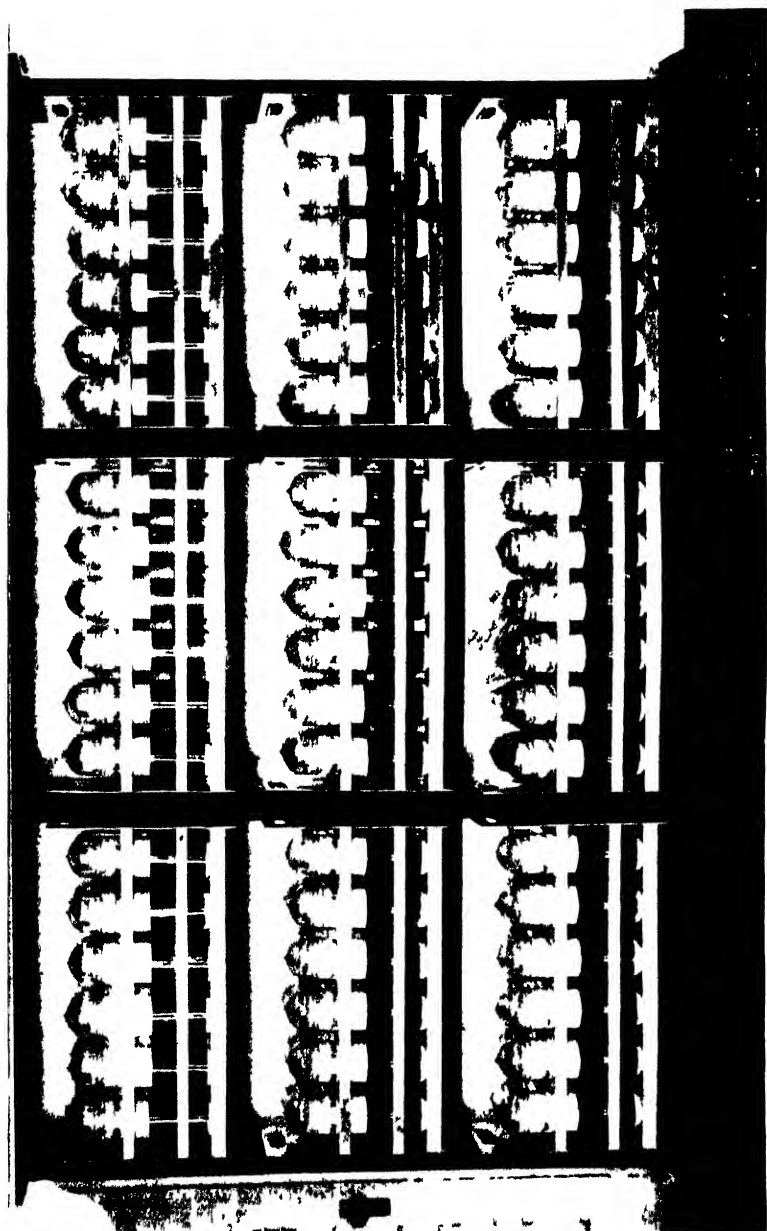


Fig. 20. — Set of vacuum tubes containing 1 copy of the official cotton standards of the United States

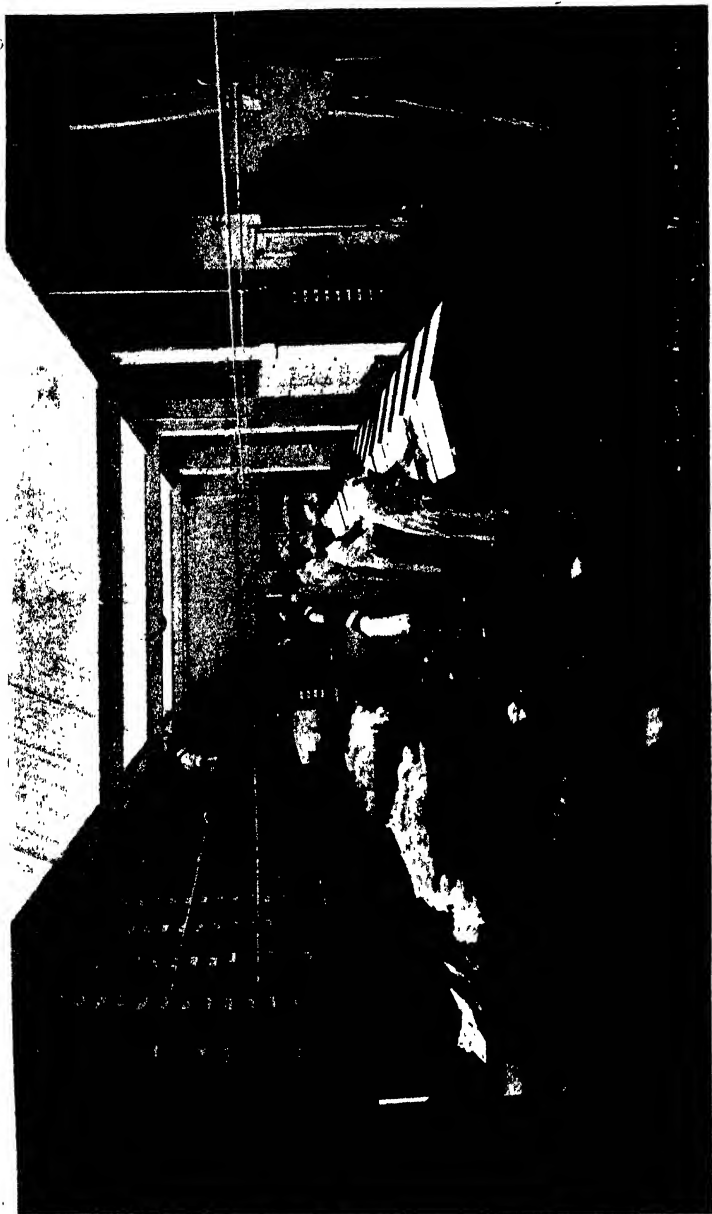


Fig. 71. — Cotton classification laboratory ; final inspection.

partment of Agriculture will be binding on all officers of the United States and will be accepted in the courts of the United States as *prima facie* evidence of the true classification of the cotton itself or of the sample thereof when involved in any transaction or shipment in interstate or foreign commerce.

The United States Government under the law is authorized to prepare copies of standards and to sell them at cost to any person, whomsoever requesting the same. These copies are to be certified under the grade seal of the Department, and the attachment of that seal will include regulations for the inspection, condemnation and exchange of standards in order to make certain that copies in use are accurate and suitable for commercial purposes.

Persons who tamper with, alter or change copies of standards excepting those who have the written authority of the United States Government to do so, or who use the standards with intent to deceive or defraud, or who counterfeit or simulate copies of the standards, are subject to a fine of \$1000, or imprisonment or both. The same penalties attach to persons who falsify or forge certificates, or who knowingly classify cotton improperly, and persons who knowingly influence, or attempt to influence improperly the classifiers licensed under the Act.

HOW MAY UNIVERSAL COTTON STANDARDS BE ESTABLISHED.

The above history of standardization shows that although the uniform standards for cotton grades have been made effective throughout the United States and although in principle the adoption of such standards has been approved and recommended on numerous occasions by accredited representatives of the European cotton industry, it remains for Europe to take another step if the advantages of such an arrangement are to be made available for the common good of European spinners and consumers of cotton.

In view of all the circumstances, the simplest and most direct way to bring about the establishment of universal standards for American cotton would appear to be for the cotton exchanges and spinners' associations of Europe to adopt the Official Cotton Standards of the United States for American Upland cotton. By the term "Upland" is meant all growths of cotton produced within the United States, with the exception of the Sea Island and American-Egyptian varieties. In making a proposal for the adoption of the

Official Cotton Standards of the United States as the basis of the world cotton standards for American cotton, there is no implied criticism of any other standards, and the recommendation is made solely for reasons which appear to be sound and fair. Even the present American standards have the sanction and recognition of the laws of the United States, and the Government has spared no expense to provide for and safeguard their accuracy. The standards for grades became legally effective in February, 1915, and have attained general use in the United States in their original form. They govern in all deliveries of cotton on American future exchange contracts, and have been officially adopted by all important American spot cotton exchanges and by the two principal organizations of American spinners. In addition they are recognized in the laws of several of the States, and American producers, merchants and spinners alike have found them a dependable and satisfactory basis on which to conduct their business.

It should perhaps be explained that in advocating the adoption of the Official Cotton Standards of the United States, it is not contended that all of the present standards are perfect, nor that some changes would not prove to be desirable or acceptable. If changes appear to be necessary to any important section of the cotton industry, the United States Department of Agriculture is willing to co-operate in the task of determining proper modifications, the attitude of the Department being that uniformity of the standards is the consideration of greatest importance.

The adoption of uniform standards would in no way prevent or interfere with the practice of any European spinners who buy their supplies of cotton according to their own private marks or types. It is with respect to the vast amount of raw cotton bought on description by Europe from America that uniform standards are needed. The United States Department of Agriculture stands ready now as it has in the past to meet Europe half-way in an effort to eliminate from the international cotton trade the lost motion that is now present. As far as possible merchants and spinners should be freed of the arbitrations and the reclamations that follow. If this should be accomplished, it will be possible for American shippers to sell to European merchants or spinners at prices which will not necessarily include the reclamation which the shipper now anticipates at the time of his sale he may have to pay after the arrival of his shipment in Europe.

PLATE XXII

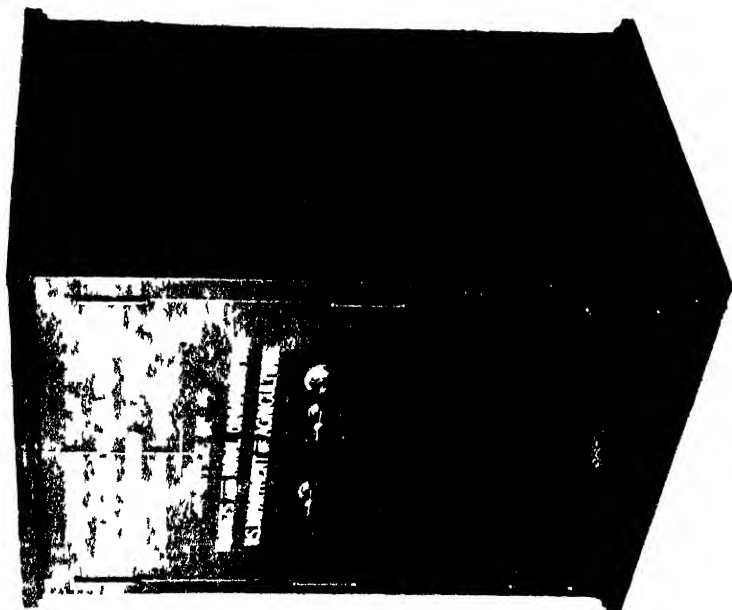


FIG. 1.—Safe containing the first set of cotton-staple kept at the U. S. Treasury.

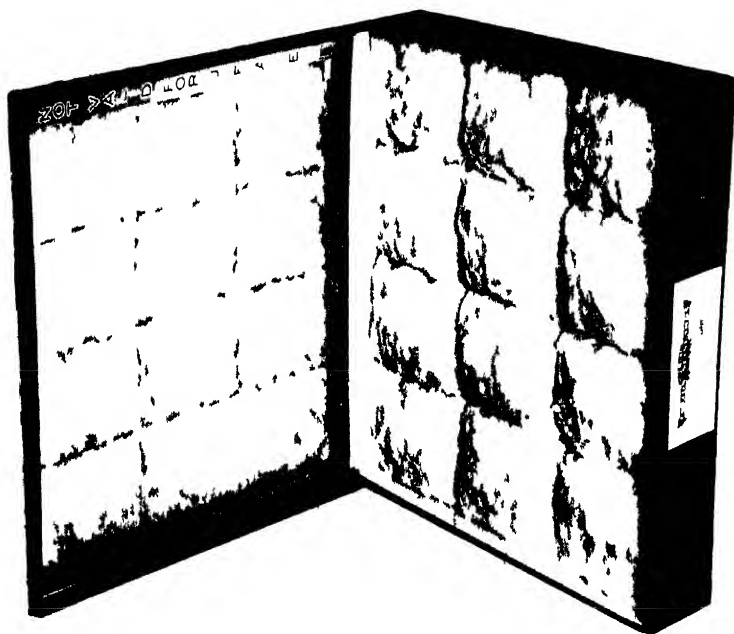


FIG. 2.—First Milling cotton No. 5 at the new staple for white cotton, effective August 1, 1905.

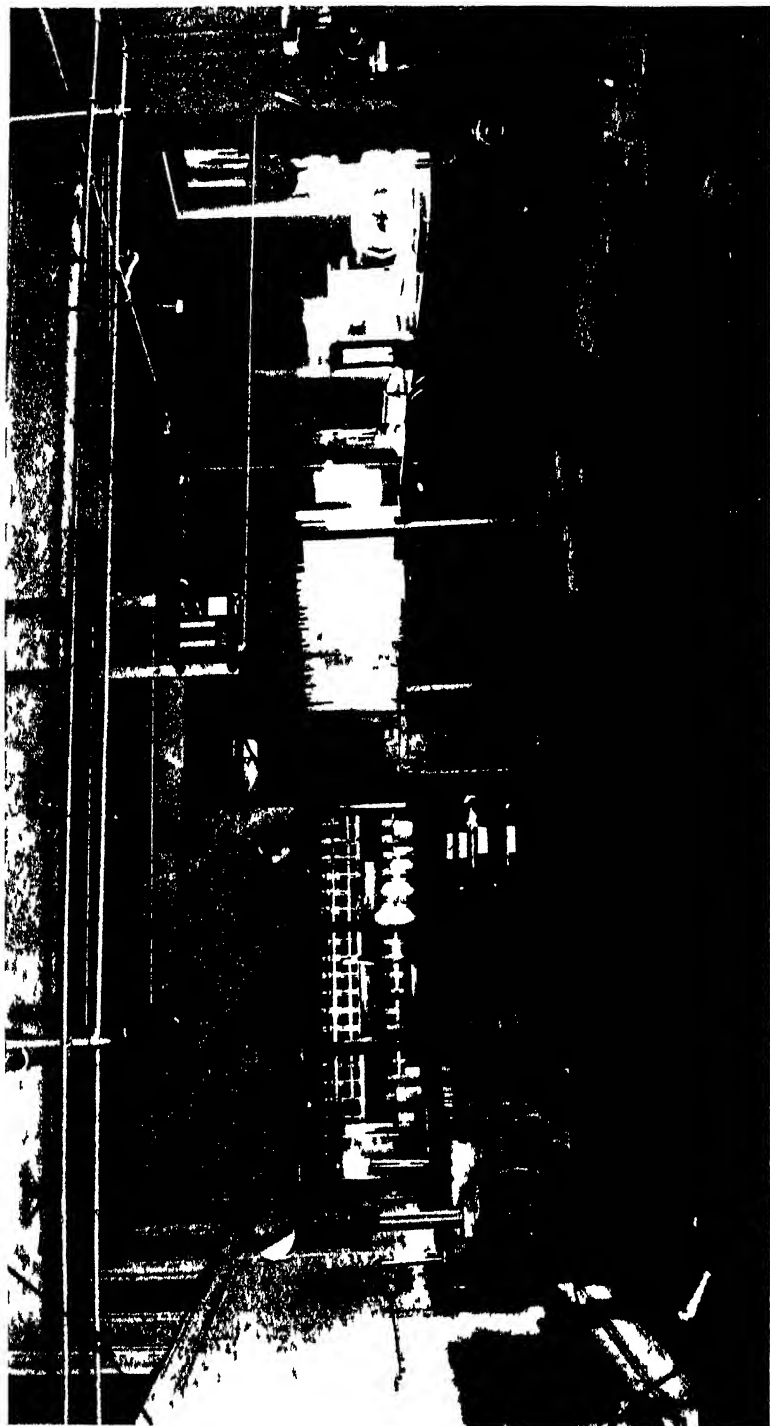


FIG 74c — Cotton testing laboratory showing yarn tester rack, scales, automatic humidity control and set of vacuum tubes

The Official Cotton Standards of the United States for grade, contain type samples taken from actual bales of cotton produced in each of the three sections of the cotton belt, commonly known to the international trade by the terms of Upland, Gulf, and Texas. Copies of these standards are readily available, and they are well known to all American shippers. Means are already at hand by which the proper grade can be determined with practical certainty before shipments are made.

In order to promote a fuller understanding, the United States is ready to furnish demonstration sets and such explanatory as may be necessary in the beginning, without cost to European spinners. It is possible to specify any growth of cotton desired and its grade under one established standard without the necessity of having or maintaining a separate set of standards for each growth. Greater simplicity will result, failure to meet grade requirements will be unjustified, shipments are more likely to be made according to contract terms, and the European spinner can be assured that the cotton purchased is of the grade specified without the necessity for an arbitration after the arrival of the cotton in Europe, with the attendant delay, uncertainties, and expense.

This is not possible under present conditions when there exist in Europe standards different from those in America. The European standards are practically unobtainable in the United States, and the expense is almost prohibitive. Consequently, they are relatively unknown. Among the American shippers who make contracts based on European standards, very few have ever seen these standards or have personal knowledge of their contents. It is not astonishing, therefore, that the present costly, unnecessary, and unsatisfactory system of arbitration is in existence.

The United States Department of Agriculture is the Official agency for the establishment and enforcement of the American official standards for the cotton trade. These standards are prepared and maintained by a non-political organization of impartial and sworn cotton experts drawn directly from the cotton trade, and their work has its sanction and approval. In these proposals, the Government of the United States represents the wishes of the American cotton trade repeatedly expressed by authorized agencies.

It can readily be seen that the United States Department of Agriculture and the American Cotton Trade have been active and have gone far to secure uniform standards and the economies that

would result therefrom, and that, although circumstances over which they have no control have delayed the achievement of this much desired end, its merits are fully established and have been conceded by all concerned. It is evident, however, that the support of the cotton consumers of Europe is important to the final accomplishment of the project.

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United States Department of Agriculture, Washington, D. C.*

PLOUGHING WITHOUT TURNING THE FURROW, IN AUSTRIA.

In Austria, at the present time, the fields are prepared for sowing almost exclusively by means of ploughs that invert the soil.

On the small area of level ground, iron ploughs are used, these being drawn on the larger farms by steam engines, or motor-tractors. In a few places, ploughs made partly of wood are still employed, while in the mountain districts, and wherever the ground is more or less sloping, turn-wrest ploughs are preferred. Here and there ploughs that do not turn the furrow, but only break up and pulverise the soil are also to be found, but the work of these implements is very incomplete, untouched strips being frequently left, especially in the subsoil. Further, they only break up a thin layer of soil, so that the seed-bed is of little depth and there is only a limited reserve of moisture for the crop. Since there exists in Austria an increasing tendency to cultivate more profitable crops of better quality which are naturally more exacting as regards their soil requirements, and the climate is of a pronounced continental character (with prolonged drought during the greatest heat of the summer), it will be easily understood that this primitive method of ploughing, which is totally inadequate to present day requirements is gradually being discarded, although it has the advantage of preparing a good seed-bed, and its place is being taken by modern implements that turn the furrows.

The land on well-managed farms in Austria is generally prepared for sowing in the following manner. As soon as possible after the harvest is carried, a superficial ploughing is given, the field being ploughed to a greater depth before the winter, and cereals are sown. If hoed crops are to be grown the next year, the soil is ploughed as deeply as possible before the winter. Very large clods are thus formed, especially on compact soils and in damp seasons, but this is not regarded as a drawback, for it is hoped that they will be

broken up by the frost in winter and the land left in a mellow condition (1).

Such generally speaking, are the present conditions found more or less everywhere according to the intensity of cultivation and the competence of the farmer, although local differences of course exist. Thus, where the subterranean water is near the surface, narrow, high ridges are made, separated by wide furrows that remain unsown and serve to collect the rain-water. On slopes with compact soil narrow ridges are ploughed and the trenches between them follow to some extent the curve of the ground, in order to prevent the soil being washed away. In mountain districts it is often necessary to run the plough over the field in the spring and carry back, in little carts, the soil that the rains have washed down from the highest points to the lower levels during the winter. In some places, the peasants replace all the soil that has been carried away by the rain.

In time, however, it was recognised that excessively large clods have great disadvantages, for they frequently remain intact throughout the winter, thus making it very difficult to prepare the spring seed-bed, further, they cause an irregular absorption of water, for while the external surfaces of the clods are disintegrated and softened, the nucleus remains relatively dry. When the field is levelled in spring, it not infrequently happens that particles of fine, damp soil fall between the clods and that solid blocks of earth are left on the tilled soil, which causes irregular germination. In the damp, finely divided soil, the seeds come up well and quickly, but in the dry parts of the field, germination is hindered and the seedlings are often smothered by more rapidly-growing weeds, or destroyed by the enemies of cultivated plants. It is clear that such irregular and defective germination will have a bad effect upon the growth of the crop and will interfere with the cultural operations. Much work on the part of animals and men is frequently necessary in order to break up the compact clods resulting from the habitual methods of ploughing. Clod-crushers, harrows and rammers are all needed, which renders the work more laborious and decreases the profits, but this extra outlay is indispensable, as a good seed bed must be secured. The realisation of this fact led to the elaboration of a system of ploughing (first adopted by the large land-owner, KUFFNER on his own estate of Dioseg) which differs from the preceding

(1) KRAFFT DR. GUIDO. *Die Ackerbaulehre*. Neue Auflage, herausgegeben von Fruhwirth, Berlin.

method in so far that the clods produced by the deep ploughing are already broken up in the winter by a cultivator. Therefore the field passes the winter in a better condition, the surface being mostly broken up, and only a few small clods remaining. This of course renders the spring work much simpler and more complete, while sowing can be done earlier and more rapidly, and germination is both more uniform and more vigorous (1).

This system of ploughing was tried between 1870 and 1880 and afterwards somewhat improved; but although its advantages were clearly evident, it was in general but little practised.

Friederich GLANZ, "Guterinspektor" (agricultural inspector) influenced by the experiments conducted under this system, and the results obtained from similar trials in Germany (2) as well as by the JEAN ploughing method, has devised a new system for which he is making active propaganda under the name of "Wählerarbeit" (3) that is to say, "breaking up". This method, which is distinguished from ordinary ploughing by the fact that the furrow is not turned, is now being tried throughout a large part of Austria and is being adopted in various Agricultural Experiment Stations and on many farms, and is already employed in practical agriculture (4).

The GLANZ method is based on the principle that it is necessary to avoid making clods, which are extremely difficult to break up. Further, the soil must be ploughed in such a manner that a good seed-bed is always preserved and is not destroyed to be re-made by working the land into unnatural conditions, which are produced especially by turning the furrow, and show themselves by the formation of clods, or a crust.

Therefore after proper working, the land must not be allowed to return to a bad state.

Breaking up the soil is part of the JEAN system, which cannot be applied in its entirety in a climate damper than that of Austria.

(1) KUFFMER Rudolf. Grundprinzipien der Wirtschaftsweiser der Dioeser Ökonomie. Zuckerfabriks und Spiritusfabriks A. G. Prestburg. Einverlag, 1920.

(2) TOPFER. *Anleitung zur Bodenarbestung und Saatzpflege*. Berlin, 1915.

ASCHENBACH-KANYSATIG. *Der Ackerbau ohne Bodenwendung*. Naumann, 1921.

DROOP. *Die Brache in der modernen Landwirtschaft*. Heidelberg, 1900.

DROOP. *Neuere Bannen in der Landwirtschaft*. Heidelberg, 1903.

RUCKER *Tagesfragen aus dem modernen Ackerbau, Der Boden, Seine Bearbeitung und Düngung*. Berlin, 1907.

RIPPART *Erfahrungen in Ackerbau zur Überwindung der Kriegschäden für Gross- und Kleinbetrieb* (Part 45 of the landwirtschaftliche Hefte). Published by T. Kliestling. Berlin.

(3) See R., 1916, No. 386.

(4) GLANZ Friederich. *Die Wuhlarbeit im Ackerboden*. Vienna, 1922.

In fact, it necessitates a certain interval being left between the harvest and the re-preparation of the soil, and this is only possible when the harvest is very early and the land is not prepared until very late, a state of affairs that usually occurs only in countries with long, hot summers, and not in Austria, where the hot season is relatively short (in various mountainous districts, the harvest is carried after the ground has been prepared for the winter cereals) (1).

Only in a few situations and in very good seasons, would it be possible to make the seed bed in Austria by means of the repeated use of cultivators.

Hence, more intensive work is necessary. GLANZ succeeded in preserving the seed-bed by breaking up the stubble as soon as possible after the harvest, that is to say, by ploughing the field without turning over the soil. Whereas by the old method of working, a very superficial first ploughing was given, in order to induce the rapid germination of the fallen seeds of wheat and weeds, GLANZ recommends "breaking up" the soil as deeply as possible. Since the soil is not turned over and the surface of the field is little changed, the seeds present on the soil are not carried down to a great depth, but merely covered with a thin layer of earth that allows of their germination and (the weeds that spring up are afterwards extirpated by the following ploughing. The breaking up of the ground to a greater depth pulverises the soil very thoroughly, so that it does not shortly return to its former condition as in the case of superficial ploughing. GLANZ attributes the greatest importance to the breaking up of the land as soon as possible after the harvest, for otherwise the soil being exposed to direct insolation dries rapidly and its properties deteriorate (2), but of course it is not always possible to carry out this work to a great depth (the greater the depth, the more time is required) however desirable it may be to reach the lower layers of soil, and rapidity of work must never be sacrificed, to depth of penetration.

The object of the subsequent ploughing should be to insure that the soil does not return to its original bad condition.

(1) All the agricultural periodicals regularly contain discussions on the experiments made and the results obtained with this method of ploughing, as well as enquiries respecting the manner in which it is carried out, also reports of lectures and demonstrations and the appointment of Commissions of Investigation. See: *Wiener landwirtschaftliche Zeitung*; *Nachrichten der deutschen Landwirtschaftsgesellschaft für Österreich*, etc.

(2) FRANCE, R. H. *Das Edaphon*. Stuttgart, 1921. GLANZ. *Das Wesen der Bodenbearbeitung*. *Landwirtschaftliche Fachpresse*, No. 1, Tetschen, January 1, 1923.

As a rule, an attempt is made to break up the soil to as great a depth as possible, in order to provide a very deep seed-bed which will absorb a large quantity of rain-water and place plenty of nutritive substances within easy reach of the roots. The great object of this method of ploughing is to raise, break up and pulverise all the soil and to remove the crust. None of the upper hardened surface must be left unbroken, therefore the ploughs used must have a wide share, that breaks up the whole furrow. When the land is broken up to a considerable depth, it remains in the required condition longer than if only the surface is affected for which reason deep working is to be preferred to shallow.

The object of the other operations is to still further increase the fineness of the seed-bed and keep it in good condition, therefore the use of a plough that turns over the furrow, or, of any other implement tending to produce an excessively compact structure, or clod formation, must be carefully avoided.

The best implement to be adopted is an ordinary plough from which the mould-board for turning the furrow has been removed. (Plate XXIV, Fig. 75).

According to the size and type of the farm, ploughs (with, or without, mould-board) with animal, motor, or steam-engine traction are employed. Special ploughs constructed by Messrs BIPPART of Magdeburg (Germany) and other firms are also used. These consist essentially of a wide share furnished with a movable, chisel-shaped, projecting point that penetrates first into the soil and thus facilitates the work of the share.

In spring, before sowing, cultivators alone are used, hence no attempt is made to completely break up the subsoil. Before seeding, it is well also to employ the clod-breaker, or leveller ("Ackerhobel" literally field-rammer) an old Russian implement that works like a plane, cutting the soil for a width of 1 to 1.25 m. and to a depth of 6 to 10 cm., while at the same time it breaks it up and raises it. This leveller breaks up the upper surface of the soil and compresses the underlying layers to some extent: it can be regulated to work at different depths. At the same time, its cutting edge cleanly severs the roots from the grasses and plants that have grown from any fallen seeds.

The use of wide, light harrows is also recommended; they should be employed chiefly after the seed has come up, and in spring. The harrow is needed to break up the surface crust, prevent excessive

evaporation, and facilitate the absorption of rain-water, the fixation of atmospheric nitrogen, and the giving off of carbon dioxide.

Sometimes a wooden roller is passed over the field before sowing in order to make the soil settle more rapidly, so that the seeds may find a good seed-bed.

Naturally it is necessary to clean and consolidate the soil round the roots of the cereals; the best means of rendering this work easy is to sow in double rows; GLANZ left 9 cm. between each couple and 18 cm. between the different couples. The wider interval allows the hoeing to be effected without any fear of injuring the plants.

Since in this way one row is left unsown out of three, a third of the seed is saved and a higher unit production obtained.

The fact that breaking up the land requires less labour and fewer teams than ordinary ploughing is greatly in its favour. The animals are saved the work of inverting the soil, and there are no clods to be broken by the men.

Practical experiments have shown that by breaking up the soil twice, instead of ploughing it once, a saving of 30 to 40 % of labour is effected. This economy coupled with the elimination of most of the harrowing and rolling, and of all the clod-breaking has the following advantages

- 1) The number of draught animals can be reduced,
- 2) It is easier to carry out the work at the right time in bad seasons;
- 3) It insures the more rapid and regular growth of the crops, makes the working of the fields during the vegetative season an easier matter and gives a higher unit production especially in years of drought. The relatively short time that breaking up the soil has been practised allows of no general numerical data being given. The simplified Dioseg method, from which, as has already been said, the "breaking up" system was derived gave a maximum unit increase of 15 % in dry years and of 4-11 % in wet years

The autumn of 1922 was an extraordinarily bad season, but on the farms where the breaking up system had been introduced and nowhere else, the preparation of the soil was finished at the usual time. This was possible because the new system can be applied without any fear of rendering the soil conditions worse, even when the ground is too damp to allow of the use of an ordinary plough.



FIG. 75. Two-furrow plough for surface work transformed into a "breaking up" implement by the removal of the mould-boards.

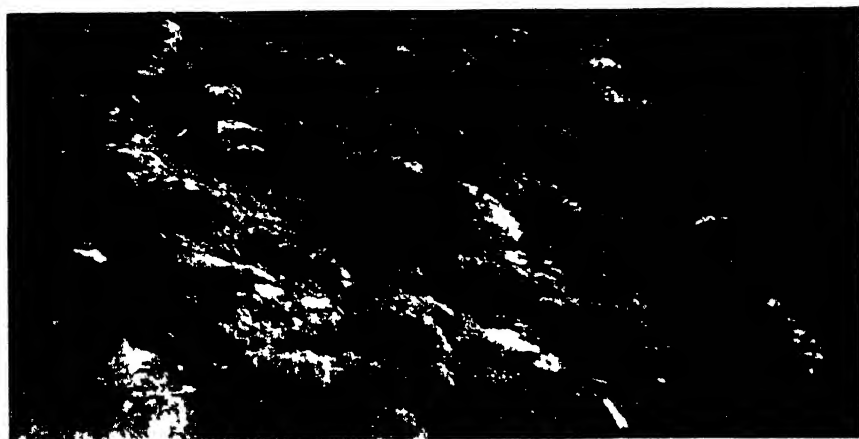
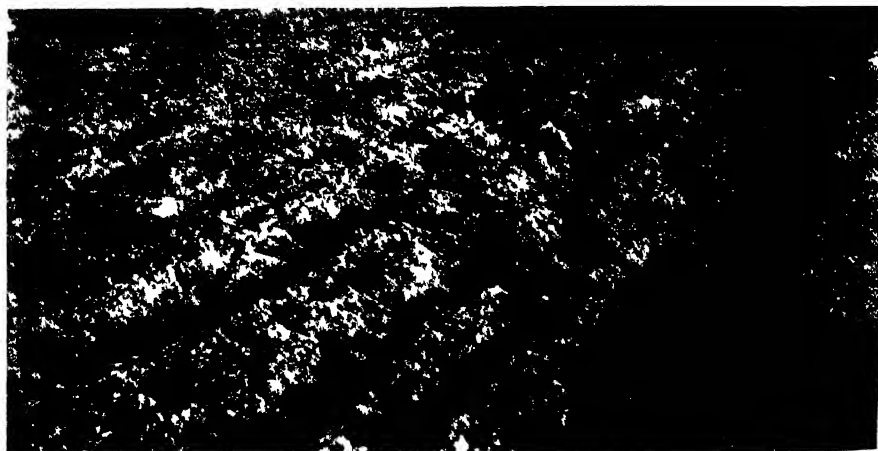


FIG. 76. Field of beetroots ploughed by turning the furrow.
(Photograph taken January 7, 1923)



When the moisture content rises, the soil can be broken up at a later stage than it can be ploughed. The photographs reproduced (see Plate XXIV, Fig. 76-77) were taken on the same day in two adjoining plots. The many bright spots on the ploughed piece show that the work was done in too wet weather, which causes clod formation, in the case of the broken up plot no such spots are seen.

Another advantage in "breaking up" consists in the fact that implements of greater size can be used so that the animals need not go on the furrow or worked ground. In dragging back the empty plough-share they incur less fatigue and there is no fear of their tread producing clods on the soil that has been prepared.

GLANZ advises farm-manure as being the best fertiliser, for the breaking up process only mixes it with a little soil and partially covers it. If straw litter is used, he advocates its being turned in with a disk harrow.

The green manure crops wither as a result of their roots being cut off during the first "breaking up" of the soil; part of the vegetable matter is mixed in then and the rest at the second "breaking up". In the same way, the weeds are removed and go to enrich the soil, but the couch-grass remains on the field, though it is uprooted and freed from some of the adherent soil, but it may be removed by the cultivator that follows the plough used for breaking up the ground. If the cultivator is not preceded by the plough, there is some danger of the couch-grass being only partially removed from the ground, which will be again infested by new plants produced from the fragments that have been left. Naturally it is necessary frequently to remove the pieces of couch grass roots that become impaled on the tines of the cultivator. When the ground is infested with the weed, the cultivator must be used again and followed by a horse-roller. By this means, all the hand-labour is avoided which is indispensable if the soil is turned, for then the roots are broken and most of them are carried down to a greater depth.

Light soils should never be broken up, though this treatment is often adopted in the case of compact soils which rapidly agglomerate. GLANZ also draws attention to the advantage accruing from applying straw litter to soils, especially those of a light type. The ground is covered for a fairly long time with manure, withered weeds, etc. If the soil is then carefully broken up, this protective layer which is very useful, because it prevents the dew evaporating, can well be retained in the surface layer.

The opponents of the "breaking up" system say that straw litter does not make a sufficient covering to the soil and therefore allows loss of nitrogen. Another objection brought forward is that with the implement used it is not possible to thoroughly incorporate the stubble, weeds, manures etc. with the soil, so that the surface of the field does not appear clean. The last observation is not of any particular weight, for according to GLANZ, the losses of nitrogen can be reduced to a minimum by using only chopped straw and short manure.

The theorists insist that the soil colloids and the nutritive substances of the plants, especially lime, are continually transported to lower levels, which is not possible when the furrow is turned, as in this case, substances from the deeper layers are brought to the surface. To this we may reply that the roots penetrate to the deep-seated layers of the subsoil and abstract nutritive substances from them, further in turning the furrow, the plough share does not reach a sufficient depth to be able to bring to the surface the colloids of the subsoil, or any nutritive substances that have been carried down more than a slight depth. Moreover, a thorough ploughing can be intercalated between the "breakings up" of the soil, when it is necessary owing to the surface layer being composed almost entirely of sand, and the clay particles have been carried down to the lower strata (which would certainly only occur after many years). As has already been said, the system of "breaking up" the soil is still in the experimental phase. It is necessary to test it on all types of soil and under all local conditions, and especially in years when the climatic conditions are very different, before any general rules for its application can be formulated.

Thus, it will only be possible to ascertain the effect produced on production and profit by the new method when it has been practised for several years.

The rapid spread of the new system and the animated discussion between its partisans and opponents have, however, aroused the interest of agriculturists in ploughing methods which will do much to solve the various problems involved. There is certainly no doubt that as the present operations leave much to be desired, a better and more thorough ploughing of the fields would increase crop production.

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THE AIMS AND ORGANIZATION OF THE PLANT PATHOLOGICAL SERVICE DOMINION OF CANADA.

In order to comprehend more readily the problems, aims and organization of the phytopathological service of the Dominion of Canada carried on under the Federal Government, as well as the difficulties to be met with, brief reference is here made, by way of introduction, to the exceedingly varying conditions of the country as a whole.

Inasmuch as the Dominion of Canada extends from the Atlantic to the Pacific for a distance of some 3,000 miles, and north and south from Latitude 42° to several degrees beyond the Arctic circle, and as there occur large bodies of inland water, and the altitudes range from sea level to alpine heights of some 19,000 feet and more, one will readily understand the diversity of climatic and related conditions affecting plant life generally.

With brilliant sunshine both summer and winter, with a temperature range from 98-100° F. on hot summers' days to some 50° below zero in some localities, with the heavy precipitations along the coast and areas with desert-like lack of moisture, one can gather some idea of the problems confronting the producers of agricultural or horticultural crops in order to obtain profitable crops, that may be grown so successfully in our Dominion.

From tender, luscious peaches and grapes in our mild regions of Southern Ontario and the fertile valleys of British Columbia, to the hardy varieties of grain and fruits to be found far up north, Canada includes a singularly wide range of crops.

Owing to these conditions it was the principal aim of our organization to establish the closest contact with the actual cultivators throughout the Dominion. Rather than carry the problems of a plant pathological nature to one centre, where climatic conditions may be unsuitable for certain crops and a study of their diseases,

it has been our endeavour to make provision for the study of the diverse problems by establishing a chain of plant pathological laboratories from the east to the west, from south to north. Such organization enables us to keep in close touch with the problems of certain regions; naturally the location of such branch laboratories was made according to representative methods of farming or fruit-growing. It also enables the Department to secure accurate information as to the prevalence of diseases and their economic importance generally and any particular problem individually. As a result of their organization the Dominion of Canada has been enabled to maintain a very close plant disease survey, which is made every year and which conveys a very comprehensive idea of the economic importance of plant diseases as they affect national wealth and prosperity.

The entire plant pathological work is under the direction of the Dominion Botanist, whose office and central laboratories are located on the grounds of the Central Experimental Farm of the federal capital, Ottawa, Ontario. This centre keeps in close touch with each of the branch stations; it is the depository for the results of the year's research data as well as the administrative headquarters of the plant pathological service.

At headquarters the staff consists of the chief officer, experts in physiology and anatomy, leaders in forest pathology, bacterial diseases of plants and laboratory routine. A very considerable correspondence is dealt with from this office, in this manner the central office serves as an inquiry bureau for the cultivators of any kind of crops throughout the Dominion.

A laboratory with up-to-date physical equipment, a fairly comprehensive technical library, greenhouses and experimental grounds, as well as an arboretum of sixty-five acres in extent, are at our disposal for the work.

Besides the general supervision and administration of the work, Ottawa serves as the centre of the plant disease inspection and certification carried on under the Federal Destructive Insect and Pest Act, which includes the administration of the various legislative measures in force directed against the introduction and spread of plant diseases generally, as well as with the inspection of plants for export purposes. In Canada the allied work of entomological nature and that phase of the Destructive Insect and Pest Act relating to

insect pests, is under the jurisdiction of the Entomological Service of the Department.

Research work is undertaken at headquarters on special phases of plant pathology and physiology, such as the relation of temperatures and light to plant life generally, researches on the diseases of forest trees, tobacco diseases and bacterial diseases.

In addition to these phases of work there is directed from headquarters a Dominion-wide system of field and tuber inspection of potatoes for seed purposes. Some idea may be gathered of the extent of this work by stating that, in 1922 an inspection was made of 11,250 acres of potatoes located in various districts throughout the country, from Prince Edward Island to Alberta. This inspection is made according to a very high standard of freedom from disease, and fields which fail to qualify under these standards are given no further consideration for seed purposes. This work has been in progress now for eight years, with the very gratifying result that there is now being produced in the country a large amount of seed potatoes practically free from disease, which has established for itself a wide and favourable reputation not only in Canada but beyond her borders.

The following is an account of the location of our branch laboratories with an indication of the work carried on under local supervision.

Thus, starting from the Atlantic to the Pacific, a laboratory was established in the Gulf of St. Lawrence Province, Prince Edward Island, at Charlottetown. This province is eminently successful in potato growing, and is generally one devoted to mixed farming. Diseases of potatoes — particularly mosaic and leaf roll — root and truck crops are being studied.

At Fredericton, the capital of the Province of New Brunswick, a laboratory is maintained for the study of the general pathology of all crops the principal work being to supply the needs of the locality. The same may be said of a laboratory situated at Ste. Anne de la Pocatière in the Province of Quebec.

Investigational and research work on fruit crops is carried on in widely separated regions, viz., Kentville, N. S.; St. Catharines, Ont.; and Summerland, B. C. Nearly all these areas have their special problems. In Nova Scotia the scientific control of scab of apples and European apple tree canker are important problems,

while at St. Catherines, diseases of small fruits are of principal importance. In British Columbia interesting physiological effects result from irrigation of orchards, and drouth spots, root injury, stippen, etc., may be referred to under this group. One of the important problems of research relates to the successful control of fire blight.

Our next group of laboratories includes those at Winnipeg and Brandon, Man., Indian Head and Saskatoon, Sask. These laboratores are situated in the prize grain belt of the world, with a production of wheat, oats, barley and flax of a value of well over \$650,000,000.

Among specific diseases affecting grain such as smut, root rot, and wilt of flax, etc., the greatest problem remains the black stem rust of wheat, and the laboratories mentioned are co-operating with provincial and university authorities in an endeavour to solve this extremely important problem. There is carried on in conjunction with this problem a wide propaganda to get rid in these provinces of all common barberries and incidentally all European buckthorns to reduce losses from crown rust of oats. Researches so far conducted have revealed the existence in Canada of a considerably number of biologic strains of *Puccinia graminis*. Their discovery, largely due to the painstaking efforts of the officer in charge at Saskatoon, will, it is hoped, facilitate the breeding of rust proof varieties of commercial value similar to our best bread wheats.

Any inquiry relating to any phase of the work here briefly reviewed, should be addressed to the Dominion Botanist, Department of Agriculture, Experimental Farms, Ottawa, who will be glad to render any assistance to workers in other parts of the world.

From the above notes it will be seen that the service which the Dominion Government provides is an organization very similar to the requirements outlined on the occasion of the International Conference on Phytopathology held in Rome in 1914. Apart from the federal service, no special services are maintained by the provincial governments, with the exception of the Province of British Columbia, which maintains a very useful plant disease inspection service in charge of a special officer. With this officer is associated a plant pathologist in charge of work of this nature in British Columbia.

The other provinces maintain advisory services in connection with their agricultural colleges and work in close co-operation with the federal service. Mention may also be made of the valuable

assistance in training of plant pathologists by the Canadian universities and colleges ; without such help it would be exceedingly difficult to do justice to the many research problems. At a later date it is hoped to discuss some of the more important phases which also have international aspects.

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THE "INK DISEASE" OF THE CHESTNUT.

This disease well deserves its name, for when it attacks the roots of the chestnut tree, a characteristic black substance is formed which extends upwards in the direction of the trunk and downwards to the main radicle system from which it exudes and impregnates the soil, with which it makes a dark-brown paste

The disease was the object of research and experiment on the part of the late Professors BRIOSI and FARNETI, of the Botanical Institute of Pavia, and of Prof. PETRI, of the Higher Forestry Institute at Florence, for after its first appearance it continued to spread rapidly, in spite of the drought, to which indeed it was erroneously attributed. All the able and ceaseless efforts of Prof. FARNETI who gave his last years to the welfare of his beloved Apennines, were powerless to check the advances of this insidious foe.

The unusual dryness of this summer has been injurious to trees no less than to herbaceous crops, and the chestnut woods of the Emilian Apennines have suffered to such an extent that the minds of the mountain agriculturists have reverted in face of such serious and unexpected damage, to the temporarily forgotten "ink disease".

During the "Settimana del Castagno" (Chestnut Week) at Cuneo, this disease was the subject of much amicable discussion by two eminent phytopathologists, MONTERMARTINI (the inheritor and supporter of the views held by his teachers and colleagues at Pavia) and PETRI (the discoverer of the parasite of the chestnut tree).

The following summary gives the chief characteristics of "ink disease" together with a some brief observations made by the author.

The progress of the infection was not arrested by the experiments carried out by Prof. FARNETI, who hoped by removing the infected roots to restore the equilibrium between the crown of the tree and the radicle system, although he took the precaution to treat the wounds with copper sulphate and sulphuric acid, as well as to cover the cut

surfaces with tar. Another affection sometimes confused with the "ink disease" is "nerume" which disfigures the fruits and only reveals itself at the time they are used. "Nerume" does more damage some years than others according to the extent that the chestnuts are parasitised. Since there is no external difference between the sound and the diseased chestnuts, the latter can be sent to the market without raising any suspicions, and it is only when they are kept in large quantities in damp storehouses, or closed trucks on the frontier, for instance, that they become mouldy and decompose. In such a condition, they cannot be eaten, or used for industrial purposes, as they have an unpleasant smell and nauseating flavour, which is imparted to any substances made from them.

The effects of "nerume" show themselves in this manner to the consumer, whereas the chestnut grower sees the twigs and secondary branches wither as the cankerous bands spread down to invade the largest limbs.

BRIOSI and FARNETI regard *Coryneum perniciosum* as the specific agent of "ink disease", but the French mycologists are of opinion that this fungus is a secondary phenomenon and not the real cause of the infection which seems to descend from the top of the tree to the roots. The two Italian phytopathologists base their opinion of the parasitic character of "ink disease" upon the following facts: the first sign of infection is invariably the withering of the extremities of the branches and of the lower shoots; dark, cankerous bands make their appearance on the affected tree and can be seen upon its external surface; *C. perniciosum* (or other forms of this fungus) are always present on the infected branches. Ink disease can be artificially produced by inoculation with *Coryneum* spores.

PETRI is of opinion that the disease is caused by an external parasite which attacks the tree a little above the level of the ground, in the region of the root-collar, or at the base of the largest roots. He however, considers the specific cause to be *Blepharospora cambivora*, a Saprolegnacea which grows first as a saprophyte on the old cortex of the trunk and produces spores in the presence of water, thus propagating itself rapidly. The oospores formed in the infected tissues of the young plants as soon as the seeds germinate, develop chiefly at the expense of the cambium, and when this is destroyed, the alburnum is quickly invaded by a fungal saprophytic flora the development of which has made it difficult to determine the true source of the disease.

PETRI supports his statements by the following alleged facts almost all of which are contested by BRIOSI and FARNETI. He asserts that. 1) the most seriously injured portion of the tree is always the base of the trunk ; 2) collar-rot invariably precedes the parasitic withering of the branches ; 3) no continuity exists between the *Coryncum* mycelium and the blackened region at the base of the trunk ; 4) the disease with all its characteristic symptoms can be produced by artificial inoculation with the parasitic mycelium.

Coryncum perniciosum and its allied forms find particularly favourable conditions of growth in chestnut-trees already suffering from Ink disease, and without producing any specific primary malady induce a secondary infection. The author himself is inclined to PETRI'S view, which although it has not been confirmed, is the result of much careful investigation, for apart from the fact that the two pathogenetic agents work in contrary directions the one downwards and the other upwards, there is no opposing tendency between them, both being concerned in the destruction of the roots and of the same infected zone of the trunk. Any removal of portions of the tree, except in the usual course of pruning, has not been suggested hitherto, nor does it promise to yield satisfactory results. No useful purpose could further be obtained from an enquiry into the origin of the disease in chestnut woods that have been destroyed, or are in process of perishing, for such an attempt would fail owing to the greater damage inflicted by the War. Experiment plantations, and trial grounds composed of Japanese chestnuts from Japan or the West have all been involved in one common ruin.

The fact that the organic continuity of the parasite on its passage down the tree cannot be followed, and that sound, young shoots may grow out of roots infected with Ink disease would appear to prove that the infection is not transmitted from one set of organs to another and that the two rival theories (according to which the disease does not begin on the roots, but on the branches), are untenable. Therefore much remains still to be done, especially in the way of fieldwork which is much more useful in this connection than laboratory research.

The thorough examination made by FARNETI of chestnut trees subjected to destructive treatment at Cima Lotti, in the Modenese Apennines, has given many contradictory results that are difficult to explain, as during the War these woods were necessarily neglected. Near to individuals in which the disease has been arrest-

ed by the removal of the infected portions, there stand dead, or dying, trees, the object of no less energetic and careful treatment.

FARNETI came across one chestnut which had had been deprived of all its root branches except one, and of a similar amount of its crown; the trunk was propped up by two large curved branches which after eight years still support the mutilated tree that continues to produce leaves and fruit on its remaining boughs. It is fortunate that, so far, the parasite has shown no tendency to spread from the chestnut to other fruit trees. Satisfactory results from the fruit-growing standpoint have been obtained in the Modenese Apennines by substituting good varieties of Italian or French pear and apple-trees for the chestnut, but owing to the lack of adequate and rapid means of transport, the venture has proved a commercial failure, although some of the varieties grown are in no wise inferior in quality to the choice fruit of the Upper Adige. The strong winds that prevail, however, frequently cause the crop to fall before it is sufficiently ripe to be marketable. These technical and commercial conditions combine to make the peasant regret his lost chestnut-trees that furnished him with bread and other products. The reafforestation work of the Federazione Pro Montibus may be able to save both the woods and the mountain dwellers. There is also much to be said in favour of removing the infected portions of the radicle system, for the few remaining roots continue to develop.

It is a curious fact that chestnut-trees are equally attacked whether they grow on dry, sandy soil, or in close proximity to some stream, and as the nature of the soil in mountainous districts changes within very short distances, the disease plays the same havoc on naked sun-baked slopes as in deep, narrow valleys where the transported soil readily collects.

If water is the transporting agent of the disease, we should expect the latter to be most prevalent on the low-lying ground, but the data on this subject are contradictory, for it has been observed that though the immunity of the chestnut increases as the tree reaches the limit of its growth (being considerable at altitudes of 700 to 900 metres and higher) as for instance at Ospitale and Fienarola and in the neighbouring district; the chestnut-trees of Serrazzone are almost as much attacked as those of Cima Lotti. At Fontana di Monte Luccio, which lies in a deep wind-protected valley, however, many trees succumb. The author is inclined to regard water as a vehicle of infection, as the disease is most common where

stagnant water collects, and if the ordinary conditions connected with the life of the chestnut are considered it is found that age exercises no definite influence, for while some veteran trees are still thriving, young trees of twenty years of age are found to be already dead. Such a state of affairs is indeed very general, as is proved by the observations made at Cuneo, Mondovì and Saluzzo. It might be expected that irrigation with spring water would contribute to the spread of the disease, but in point of fact, the disease is as severe on dry as on damp soils.

The hypothesis that cropping might lead to a diffusion of the disease as a result of the various cultural operations involved does not seem likely, since on land which is worked and sown with lucern or broom, the chestnut-trees profit by the tillage and grow more vigorously.

Owing to the multiform character of the disease, the author recommends that the dead trees should be destroyed and the land limed, this being the most economical treatment. Young healthy trees can then be planted — preferably Italian chestnuts at first — for if these prove later to be less resistant than the Japanese variety, they can always be used for reafforestation. No new trees ought to be planted in the place of dead specimens. The destruction of the diseased trees may be carried out in the manner adopted by the late Prof. FARNETI, the reconstitution, after the soil has been limed and allowed to rest can be effected according to the usual methods. It is difficult to keep the humus of a chestnut wood free from the mycelium of the parasite without the application of a strong solution of Bordeaux mixture (with the addition of 1-2 % of fish-glue) to the lower portion of the trunks of the infected trees, which is certainly a more costly and troublesome measure than the simple plan of covering the lower part of the trunk with straw, as suggested by GARBASSO.

As regards curative measures, in countries where the chestnut-trees are periodically pruned, the pruning operations are directed by a careful observation of the cankerous, depressed bands descending from the smaller to the larger branches. The internal treatment devised by BRIOSI and FARNETI which consists of making the tree absorb, by means of a special apparatus, exceedingly dilute solutions of sulphate of copper, or of iron (1 in 5000), seems at present to have a merely scientific interest, although it is to be hoped that it may be of practical importance in future.

During the "Chestnut Week" at Cuneo, the following preventive measures were suggested: no live chestnut trees should be allowed to be exported from areas known to be infected; no chestnut-earth should be imported into immune areas; no chestnut leaves or chestnut earth, should be used for manuring nurseries in which are reared young fruit-trees intended to be exported from a Commune that is recognised as being infected.

It is also advisable to sprinkle lime over the leaves collected in heaps for manure, or other purposes and to report to the Phytopathological Institute, the Travelling Agricultural Instructor, or the Forestry Inspection Service any cases of dead trees in the chestnut woods under their supervision, and to fell immediately all dead, or diseased, chestnut trees in areas known to be infected.

All infected stumps should be uprooted and the surface of the ground within a radius of two metres must be disinfected with the solutions of copper previously mentioned. In the case of a considerable extension of the infected area, even if only of recent date, the chestnut-woods that are still healthy ought to be periodically cut down.

The recognition of the necessity for organisation in order to efficiently control the malady has led to the compulsory, or voluntary, creation of Societies for the Protection of Chestnut-woods on the lines laid down by the law of 1913.

The reserve shown by the experts in expressing definite conclusions regarding the subjects treated of at Cuneo was particularly noticeable in the case of the Ink disease. They contented themselves with speaking of the "possible and probable control", a phrase which, while it does great credit to their scientific honesty, leaves us in doubt as to the course to pursue.

With regard to preventive measures, the efficacy of grafting the Italian Chestnut on the Japanese variety (*Castanea mollissima* or "tambu", is still a doubtful question, since the disease resistance of the stock and the graft-affinity between the two varieties are by no means certain.

MANGIN himself, although he agrees with PRUHET in recommending the Japanese chestnut as a stock, allows that decisive results can only be expected after several years.

The grafting experiments made by FARNETI at Fanano did not prove successful, either owing to the probably spurious origin of the Japanese chestnut which perhaps came from America — to want

of graft affinity, or to the fact that the stock being a native of a warm country with a maritime climate, suffered from the continental climate of Italy and the conditions obtaining on our mountains.

Judging by the results of reconstituting phylloxera infected vineyards in Sicily with American stocks, it will require time and experiment to show whether the Japanese chestnut is really resistant to the attacks of *Blepharospora cambivora*, a fungus hitherto unknown in Japan and which, until it attacked our chestnut-trees, was a harmless saprophyte in Italy.

The progress of the Ink disease has been gradual, keeping pace with the gradual adaptation of the fungus to a parasitic mode of existence. Only in the case of the artificially infected chestnut-tree of the Pavia Botanical Gardens did it assume a sudden and violent form.

The most effective control measures will be those based on the life-history of the parasite. Just as in the case of vine-pathology, an empiric remedy (Bordeaux mixture which has now been improved to the point of becoming the sovereign cure of peronospora) was applied, so in that of the chestnut an empiric remedy may be adopted. At Chiusa Posia, all the leaves, chestnut-capsules and other detritus that collect at the foot of the trees are removed and burnt. This might be done elsewhere in the late autumn, when with proper care, there would be no fear of causing forest fires.

With regard to the possibility of cultivating resistant species of chestnut to replace the trees that have succumbed to the attack of *Blepharospora cambivora* in the chestnut woods destroyed by the Ink disease, recourse may be had to the "tambu" variety of *Castanea crenata*, a native of the Far East. A similar measure is adopted in the case of the sugar-cane in Hawaii where no other varieties may be grown but those resistant to "sereh", mosaic and Fiji disease; one such variety is "Badila", a cane indigenous to New Guinea, where the latter disease appears to be endemic. The following is a summary of what DUFRENOY and BLIN have said on this subject.

In his attempt to determine the factors inducing the resistance of the chestnut-tree to Ink disease, supposed to be due to *Blepharospora cambivora*, PETRI rejects the hypothesis of there being a chemical difference in the composition of the cell-sap of the Japanese and French chestnut. Although the macrochemical analysis of the cortical parenchyma of *C. crenata* shows the tannin content to be 7.10 % or only a little lower than in the case of our own chestnut,

this is due to the greater amount of bast fibre in the bark of *C. crenata*; this fibre which contains no tannin occupies the place of a certain number of tanniniferous cells. In fact, macrochemical analysis reveals no special difference in the querci-tannic acid, or gallic acid present in the cortical cells of the two varieties of chestnut. Atmospheric oxygen, however, darkens the tannic extract of *C. crenata* more than that of the Italian chestnut.

Blepharospora develops equally well on the wood extract of either variety but the presence of tannin retards its growth which ceases if the percentage of tannin exceeds 0.5.

Blepharospora can also be cultivated on sterile pieces of the wood of *C. crenata* and *C. vesca*.

PETRI inoculated the roots of 4 year-old French and Japanese chestnut-trees with the mycelium of the fungus and found that in both cases the parasite was able to penetrate through the cortex, though the Japanese variety reacts to the infection by the rapid formation of wound-callus, cutting off the diseased zone by means of layers of phellogen. It is to the rapid formation of phellogen that the tree owes its power of resistance.

The discovery in America, of a species of chestnut (*C. dentata*) that is resistant to *Endothia parasitica* has done much to control Chestnut blight and every effort is being made to extend its cultivation. *C. dentata* is, however, severely attacked by *Blepharospora* to which *C. mollissima* alone is resistant; although BLIN is of a contrary opinion, and in his study of resistant species, he mentions both *C. dentata* and *C. mollissima* which have been introduced from Japan and China respectively into France where they have proved to be very satisfactory.

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AGRICULTURAL INTELLIGENCE

AGRONOMY.

Agricultural Meteorology.

329. **The Wheat Climate in Italy.**

AZZI, G. *Nuovi Annali del Ministero per l'Agricoltura*, Year II, No 3, pp 453-624, figs 11. Rome, 1922

The chief object of this work is to use the existing observations and data relating to wheat development and to the course of meteorological phenomena, for the purpose of discovering in the complex interplay of bio-environmental correlations the main outlines of the meteorological-agricultural wheat problem in the various zones of Italy.

The author, who began as early as 1918, to make a series of parallel observations, at a considerable number of Stations, upon wheat growth and the variations in environmental values, soon became convinced of the necessity to supplement the objective and indiscriminate study of all the different factors by devoting special attention to the local problem of each district as represented by the phenomena exercising a decisive effect upon the results of the harvest

He also aimed at determining some well-defined principles and hoped to discover therein the clew of Ariadne which should guide him through the maze of the correlations existing between the wheat plant and the climate.

In order to collect the required material the following questionnaire was drawn up:—

1) State in their order of importance the weather conditions injurious to wheat, the frequency of each during a 10-year period. Give, if possible, some information as to the intensity of these meteorological phenomena

2) What are the meteorological phenomena which although they have no direct injurious effect, yet favour the development of diseases, insects and weeds?

3) Give the varieties of wheat cultivated in the zone, stating in the case of each:

a) the approximate area occupied in % of the area under wheat;

b) whether the said area tends to increase, or decrease, and the causes for these changes;

- c) the behaviour of these varieties as regards inclement weather.
- 4) The dates of sowing, heading and harvesting.
- 5) The altitude limits of wheat cultivation.

The Travelling Schools of Agriculture in Italy, the Agricultural Colleges, Experiment Stations and numerous agriculturists collaborated to insure the success of this enquiry and furnished over four hundred reports that could be used in the work.

The author has divided his work into five parts :

- I) *Regional monographs.*
- II) *Phenoscopic maps.*
- III) *Classification of adverse phenomena*
- IV) *Classification of the varieties of wheat.*
- V) *General conclusions ; the ecological problem of wheat.*

Regional monographs : Short accounts of the general conditions of the configuration of the zone and the climate ; the distribution, frequency and intensity of the meteorological phenomena injurious to wheat ; the geographical distribution of each variety especially as regards its behaviour under inclement atmospheric conditions. The monographs succeed one another in the following order : Sicily, Sardinia, Calabria, Basilicata, Apulia, Campania, Abruzzi, Latium, Tuscany, Umbria, Marches, Emilia, Venetia and Trentino, Lombardy, Piedmont and Liguria.

At the end of each monograph, a recapitulatory statement is given. The following referring to Sicily is quoted as an instance. —

Varieties	% of area under wheat	Total area in hectares	Yield quintals per hectare	Total quintals
Realforte	25	156 250	83	1 299 875
Biancuccia	14	87 500		746 250
Emilia	10	62 500		518 750
Sammantinara	9	56 250		466 875
Corcitta	9	43 750		363 125
Gigante	6	37 500		311 250
Fano	5	31 250		259 375
Scorzoneria	5	31 250		259 375
Majorca	5	31 250	.	259 375
Ruscia	4	25 000		207 500

The chief characteristic of the climate of Sicily from the standpoint of wheat cultivation is the unequal distribution of the rainfall and the differences in the amount of rain from one year to another. It may be said that, on an average, there is a deficiency of rain four times in 10 years, and an excess of rain once during the same period ; such variations have a decided and very injurious effect on the wheat crop.

The drought and the "stretta" (lack of moisture and high temperatures) are the factors most injurious to the satisfactory development of wheat. All the varieties of wheat grown in the island are with few exceptions, highly resistant to drought. The rainfall increases and the tem-

perature decreases in passing from the coast to the interior, so that although drought remains the dominant factor, other adverse phenomena increase in importance, thus necessitating different kinds and types of adaptations. There are therefore 3 zones, the coast, hill, and mountain zone respectively, each possessing its own distinctive varieties of wheat. From *Biancuccia*, *Sammartinara*, *Scorzonerà*, *Corcilla* on the coast we proceed to *Realforte* in the hilly land and to *Majorca*, *Castiglione*, etc. in the mountains.

Phenoscopic maps. — In this chapter, are collected, and illustrated by means of small maps, the data relating to the sowings, heading and harvest. The vegetative period is divided into 4 subperiods :

- 1) autumnal : sowing, germination of seed, first growth of seedlings ;
- 2) winter : tillering ;
- 3) spring : resumption of tillering, heading ;
- 4) summer : from heading, to ripening and harvest.

We now know that it is not the absolute value of a meteorological factor that counts, but its distribution during the different stages of the growth period. Thus for instance, the total rainfall throughout the vegetative period in no way explains the relation between the harvest and the amount of rain that has fallen. Indeed, during the subperiod between tillering and heading drought is one of the most injurious factors, whereas in the subperiod from heading to the harvest, excess of rain will certainly have a bad effect. It is thus clear, that with an equal sum of rainfall during the vegetative period, diametrically opposite results may be obtained according to the distribution of the rain. Therefore, if the total amount, of rain for instance, is divided into quantities and fractions corresponding to each subperiod, this will greatly facilitate our search for the correlations existing between rainfall and harvest.

Classification of adverse phenomena. — The author studies for each of the subperiods (autumnal, winter, spring and summer) the "excess" and the "deficiency" of moisture and temperature from the standpoints of wheat development and productivity, he also estimates the frequency of these factors during a 10-year period as well as their intensity and distribution. The following table gives the maximum and minimum thermic and pluviometric limits of the normal development of wheat, as far as it was possible to determine them during the course of these researches

Limits	Sowing	Tillering	Heading	Flowering and setting	Grain production
Pluviometric, in mm. . . .	max. 200	250	—	80	60
	min. 50	100	45	—	—
Thermic, in degrees centigrade	max. —	+ 11	—	+ 31	+ 32
	min. —	— 5	+ 2	+ 10	+ 12

The author uses a double basis of reference in estimating the losses due to bad weather

- 1) The average harvest for the period 1909-1910.
- 2) The maximum harvest during the same period.

The use of these two bases, instead of a single one which is artificially modified according to the object of the determination, presents considerable advantages from the standpoint of the quicker and better utilisation of the data available for the estimation and assessment of the risk.

1) Reckoning the loss on the basis of the deficiency in a maximum crop gives the real, absolute measure of the effect of the adverse weather conditions, but would make the risk appear too great, for this should be estimated from the average crop, upon which, indeed, is based the valuation of the capital.

2) On the other hand, basing the loss upon the average crop would make it impossible, in many cases, to determine how far bad weather decreases this average value.

In fact, if in certain districts, the rainfall is deficient in 19 years out of 20, which means an average yield of 7 quintals per hectare, and the harvest is so large the twentieth year, that the yield is doubled (14 quintals), the average yield of this year would yet be very low, viz., 7.3 quintals,

$$\frac{(7 \times 19) + 14}{20} = 7.3$$

If the estimation is made on loss due to drought, this would be nothing in years when the deficiency in rain-fall caused the crop to remain at 7.3 quintals, and the effect of the adverse meteorological conditions would thus be underestimated. It would be enough to alter the type of farming by the introduction of irrigation, in order to see at once the *depreciation* in the average crop when it is not irrigated. Indeed, irrigation finds its economic justification in the fact that it causes the complete elimination of drought factor and produces, as far as the water supply is concerned, the maximum yield. It is on this maximum that the variations in the crop should actually be based.

The two bases of reference are thus reciprocally complementary.

Owing to the difficulty in determining the particular effect of each phenomenon, the author has decided to confine himself to two large subdivisions :

- 1) Losses due to excessive moisture and deficient heat ;
- 2) Losses due to deficient moisture and excessive heat.

Italy has been divided, according to the amount of these losses, into the following geographical zones :

1) Southern arid zone *Ab* : the losses due to excessive rainfall are here very slight (19 and less per hectare) at least, three times lower than those occasioned by drought.

2) Southern rainy zone *Aa* ; here, the excessive rainfall and the low spring temperatures are the adverse factors occupying the second place and causing sometimes about half as much loss as drought. They must be taken into account in selection work (resistance to lodging and rust, as well as drought resistance).

In the zones *B* (*Ba*, *Bb*, *Bc* and *Bd*), the losses occasioned by excessive rain are equal to, or greater than, those due to lack of moisture. The following are the characters of each zone of this group :

3) Zone *Ba* : north arid ; after excessive moisture, drought (generally accompanied by "stretta") is the factor ranking second in importance ; the intensity of this phenomenon and the injury it causes may be compared in certain localities to the harm occasioned by excessive rain.

4) North zone *Bb*, where "stretta" prevails. After excessive moisture, the most injurious factor here is the "stretta" of heat.

5) Northern zone *Bc*, with fogs. After excessive moisture and a too low temperature, cold fogs during the flowering and setting are the phenomena doing most injury to wheat.

6) Northern cold zone *Bd*. Here, the cold of winter ranks immediately after excessive rainfall and low temperatures as the most injurious phenomenon.

7) Mountainous zone *C*. characterised by violent winds and severe winters.

Although this zone is partly included in the preceding zone, it is clearly distinguished from the latter by a series of special agro-geological and meteorological characters due, not only to its altitude, but to the complexity of its surface configuration which divided the physiological unity of the zones into a series of different types distributed according to the exposure of the slopes, the character of the rocks, and the vegetation.

Classification of the varieties of wheat. — This is not a botanic classification, the varieties being grouped in distinct classes and categories according to their behaviour under adverse weather conditions.

On the other hand, the working up of the meteorological data has already revealed the existence of physiological zones distinguished by their predominant adverse phenomena which form a natural basis for classification.

The author thus proceeds to study each variety zone by zone, giving in each case the behaviour of the variety towards adverse meteorological conditions, its distribution and density in the different parts of the area it occupies.

The following, for instance, is a description of "gentil rosso" (zone *B*).

Resistant to lodging and rust, but susceptible to "stretta" (Parma).

Average resistance to rust and lodging (Ferrara).

Resistant to low temperature (Betlune).

Resistant to lodging, whereas "Cologna" lodges easily (Treviso).

Resistant to drought and lodging (Novi Ligure). It resists winter cold well, but is inferior to "Cologna" as regards resistance to rust and lodging (Bergamo).

Average resistance to lodging, little resistance to cold (Cuneo).

Early-maturing, immune to "stretta", resistant to lodging (Bobbio).

Specific productivity high, resistant to lodging (Fermo).

Thus, "Gentile" is resistant to cold at Belluna — slightly resistant to low temperatures and the snow that covers the ground for a long

period at Cuneo — in fact, at Cuneo, the snow lies longer than at Belluna sometimes lasting until the end of the winter.

As regards temperature, there is no difference between these two places, the lower resistance of "Gentile" recorded at Cuneo, is probably due to the simultaneous negative action of other factors (wind, snow lying on the ground. etc.). The series of minima (Cuneo-Belluna) for the month of February approximately marks the cold limit for the profitable cultivation of "Gentile rosso" in the north

In short, this variety maintains its position owing to its high specific productivity, its average resistance to all the negative phenomena in zone B in fact, it resists rust and lodging, and penetrates on account of its relative early maturity even into zones subject to "stretta" (Bobbio). Owing to its cold-resistance, "Gentile rosso" extends as far as the Belluna sector, and can even thrive in localities invaded by fogs, or subject to want of rain, provided the deficiency in moisture does not amount to drought.

The data respecting the distribution of this variety in provinces and communes, show that it is the wheat chiefly grown in Tuscany, Emilia, Venetia and Lombardy. It has recently spread at the expense of *Rieti*, *l'Hybride de Vilmorin* (Emilia), *Cologna* (Mantua), *Montano local* (Bobbio), *Carlotta Strampelli*, *Noè* (Rocca S. Casciano), *Calbigia*, *Carpegna* and *Torrechio* wheat (Mercantino Marecchio), *Gentil bianco* (Arezzo), *Mazzocchio* (Cempio Lucca), and local varieties (in Trentino).

"Gentil rosso" has also found its way into Latium, Umbria (where it has replaced *Rieti* and *Calbigia*), the Marches, where it tends to supplant *Carosello*, and along the coast while from the Abruzzi, it has succeeded in penetrating into Apulia.

In the "Terra di Lavoro", where it finds really favourable conditions from the agro-geological and meteorological standpoints, "Gentil rosso" is very widely cultivated in the territory of Frignano Maggiore and has penetrated also into the province of Benevento. In the south, the spread of this variety is checked by high temperatures during the grain-setting and by the spring drought.

In the north, it has made its way from the coast to the Province of Port-Maurice and the extreme East and West sectors of the Province of Genoa, while in Piedmont, it continues to spread in the provinces of Turin and Alessandria. Along the boundaries of the distribution area, and even in the interior of the latter, each storm marks out zones showing the average resistance of "Gentil" to adverse factors which increase in intensity so as, at a certain point, to prevent its being cultivated and necessitate the choice of a type of wheat with high powers of resistance. This is the case, in all the wind swept mountain sectors, where low-growing varieties resistant to shelling always give the best results. Thus, *Venacchio* does well on the mountains of Garfagnana, the wind wheat (*Calbigia*), thrives in the Apennines of Tuscany and Emilia. In very low, damp localities threatened by rust and floods, such as the low-lying valleys, of Tuscany (especially those of "Lucchesia"), Umbria and the Marches, *Rieti* holds its own. In the "Marcite", of "Lomellina", or of "Canavesano" "Gentil rosso" does not prove sufficiently resistant to the damp,

cold and fogs, and has to give way before *Rieti* and *Rosso Canavesano*, while in the territory of Cremona, along the banks of the Po, "*Gentil Rosso*" has still a serious rival in the *Hybride de Vilmorin*.

In the driest parts of the south-west corner of Tuscany, *Cascola* is always the favourite variety, while in the territory of Cuneo, and in the Alpine districts where "*Gentil*" is kept in check by the low temperatures and the long time the snow lies, the predominant varieties are *Piemonte* and *Rosso di Montagna*.

The same details are given by the author in the case of the other varieties of wheat cultivated in Italy.

The following is a list of the varieties showing most resistance to adverse weather conditions, and distinguished for high productivity and the good quality of their grain. The author uses a conventional scale of values ranging from 1 (= maximum susceptibility; low productivity; bad quality of grain) to 20 (= maximum resistance, high yield; excellent grain).

Wheats very resistant to drought. 15-20 *Biancuccia*, *Nurru*, *Arrubiu*, *Biancale*, *Coccitta*, *Rossarda*, *Copinera* (19); *Realforte*, *Trigu canu*, *Trigu biancu*, *Listia niedda* (18), *Duio di Puglia* (17), *Rossia*, *Bianchetta* (16); *Sammartinara*, *Scorzonera*, *Majorcone*, *Biancolino d'Elba*, *Granone dell'Elba*, *Cascola* (15).

Very early-maturing wheats (15-20). *Rossarda*, *Copinera* (19), *Biancolina d'Elba* (18), *Realforte* (17), *Trigu biancu* (16); *Romanello*, *Cologna* (15).

Very cold-resistant wheats: *Petit rouge de montagne*, *Indigien d'Aoste*, *Locale de Domodossola* (19); *Bon Fermier*, *Gros bleu*, *Saumur*, *Poulard blanc*, *Rosso Piemontese*, *Rossetto* (16); *Venacchio*, *Restajolo*, *Borrecchio* (15).

Wheats very resistant to lodging. *Poulard blanc*, *Inversable* (18); *Noé*, *Rosso Canavesano*, *Rossolona*, *Quattro Corte*, *Civitella*, *Fucense*, *Risciola*, *Biancolino dell'Elba*; *Trigu canu*, *Scorzonera* (15).

Wheats very resistant to rust: *Carlotta Strampelli*, *Rieti*, *Fucense*.

Wheats very resistant to fogs. *Majorcone*, *Rieti*, *Bianco di Napoli*.

Wheats very resistant to wind: *Calbigia bianca* and *Calbigia rossa*.

Wheats of high specific productivity: *Biancuccia*, *Bianco*, *Preziosa*, *Francisca*, *Civitella*, *Gentil rosso*, *Rosso Canavesano*, *Bon Fermier*, *Gros bleu*, *Poulard blanc*, *Granone dell'Elba*.

The following table contains data referring to certain varieties of wheat that are distinguished by a combination of positive characters.

This table allows of an adequate idea being immediately formed as to the good qualities and defects of each variety, further, it is a reliable guide both for the agriculturist desirous of choosing the type of wheat most suitable for his district, and for the plant-breeder who aims at combining in the best proportions, so as to attain the maximum yield, the two characters of inherent productivity and resistance to the most injurious local factors.

The chief object of the author is to point out in this monograph the best ways of extending the study of the correlations between wheat de-

Varieties	Physiological zone	Lodging	Rust	Low temperatures	Drought	"Stretta"	Wind	Fogs	Yield	Quality
Biancuccia	Ab	—	—	—	20	—	—	—	18	18
Rossarda di Capinera. . .	Ab	—	—	—	20	20	—	—	7	15
Trigu canu	Ac	12	12	—	19	10	—	—	—	—
Biancolino dell'Elba . . .	Ac	15	15	—	16	19	—	—	15	—
Fucense	B	15	15	13	—	—	—	15	—	—
Civitella	B	15	12	10	—	12	—	—	20	5
Gentil rosso	B	12	12	10	—	10	—	—	19	19
Quattro corte	—	—	—	—	—	—	—	—	—	—
Rossolone and Rosso cana- vesano	Bd	15	12	13	—	—	—	—	—	—
Poulard blanc	Bd	20	5	17	—	—	—	—	18	—
Inversable	B	20	3	14	—	5	—	—	18	12
Rustajolo	C	13	13	15	—	—	15	—	—	—

velopment and meteorological factors. In addition, the monograph renders it possible to turn to account, every year from the beginning, the results of the parallel observations made on growth and on the variation in environmental values and thereby gradually to improve the classification reached by the author through working up the material supplied in answer to his questionnaire.

G. A.

Pedology.

330. The Mechanical Analysis of Soils.

I — ROBINSON G W (Adviser in Agricultural Chemistry, University College of North Wales, Bangor) Note on the Mechanical Analysis of Humus Soils *The Journal of Agricultural Science*, Vol XII, Part. 3, pp 287-291

II IDEM A New Method for the Mechanical Analysis of Soils and Other Dispersions *Ibidem*, pp. 306-321, figs 4

I. — The mechanical analysis of soils rich in organic matter is difficult, and in the case of peaty soil has only a very limited value. This is chiefly due to the fact that humus acts as a cement upon the soil particles, thus hindering their dispersion. In order to destroy the organic matter various chemicals have been used, such as hypobromide of sodium; boiling nitric acid for diatomaceous earth (fossil flour); hydrochloric acid for soils free from calcium carbonate, etc. There are, however, certain objections to these energetic reagents; thus for instance, the acid dissolves appreciable quantities of clay and other finely divided mineral matter; while alkalis attack the silica and the colloidal silicic acid present in the soil.

The author has made experiments with ammonium persulphate, but this produced a certain amount of sulphuric acid which dissolves the min-

erals of the soil, unless it is neutralised as soon it is formed, and another disadvantage is the necessity to remove the large amount of persulphate of ammonia introduced.

On the whole, however, the results obtained are good, thus in one soil of North Wales, the author found 16 % of organic matter by means of oxidation with ammonium persulphate, keeping the solution nearly neutral, as against 10.5 % found by the hypobromide method, 13.5 % with hydrochloric acid, and 6.9 % by the ordinary method, without neutralisation 13.04 % would have been determined.

The practical difficulties of this method led the author to try oxygenated water; the results obtained were still better inasmuch as a high percentage of oxidised organic substances were obtained which differed but little from that determined by ignition and a high degree of dispersion was produced as was proved by the amount of clay (in one analysis 17.9 % as against 6.2 % with the ordinary method, in another, 17.6 % as against 6.3 % etc.) The author ascertained that the strong dispersion action was not apparent, the viscosity having been reduced as a result of the oxidation, in fact viscosi-metric tests proved the viscosity not to have been appreciably altered. The clay formed in this way, unlike that separated by the ordinary method, showed silky reflexes (caused by microscopic mineral crystals) when suspended in water. These will form the subject of a later enquiry.

The technique employed was as follows: 10 gm of soil were placed in a beaker having a capacity of 600-700 cc, 50 cc of water oxygenated to 20 volumes were then introduced and the beaker was placed over a bath of boiling water, a violent reaction then took place. The mixture was stirred from time to time, after 30 minutes, the reaction ceased, 25 cc more water were added, care being taken to detach, by means of a jet of water, any particles of soil still adhering to the sides of the vessel. After heating for another 15-20 minutes the reaction is generally finished (only in the case of a soil that is very rich in organic matter would it be necessary to add more oxygenated water), 100 cc of distilled water are then added and the mixture is boiled for 15 minutes, after which the mechanical analysis is carried out in the usual manner.

II — Graphic charts are generally used in the ordinary methods unless the fractions are few; the number of fractions can be increased, but only at the expense of the accuracy of the determinations.

Accurate methods of graphic representation have been devised. ODEN registers by means of an automatic apparatus that raises the deposit at given intervals of time, but the apparatus is costly, difficult to handle and cannot be continuously used. WEIGNER has devised a modified and simpler apparatus of the same type, which consists of a U-tube with a very thin communicating portion. One arm contains the suspension, and the other pure water. Owing to the difference in specific gravity, the column of water rises higher than the other, but sinks as the sediment is deposited from the suspension, and the level of the water column is read and registered. The great disadvantage of this method is the very long time required, in fact the two columns must be about 1 m. high in order for it to be pos-

sible to register the differences in the level of the water, and as sedimentation takes place slowly through a water column of this height, the average time taken with the apparatus is 24 hours.

The author has considered another method based on the different velocity of sedimentation of soil particles of various sizes. He starts from the premise that one particle does not carry others with it as it falls. This method is explained by the graph (Fig 78) where the upper part $ABCD$ represents the material suspended in a column of liquid of the height AC . Each vertical line $a, b \dots k$, corresponds to a column of suspended material of different dimensions.

Fig 78 — Diagrammatic representation of the sedimentation

The size of the particles increases from a to k , thus for instance, a represents clay, and k represents fine gravel. In the lower rectangle $A'B'C'D'$ the lines represent the amount of the materials that has remained in suspension for a certain time, t , the black area below the line CD measures the thickness of the deposit.

In the case of each column, the sum of the suspended part and of the deposited part gives the original height.

If at this time, a little of the suspended material is taken at the depth d' , the only particles found will be those ranging in size from $a-e$ whose velocity in falling is less than d'/t , the liquid will not contain a single particle of the larger sizes $f-k$, whose velocity in falling is greater than d'/t . On determining the concentration for the different values of d'/t , it is possible to draw a graph, which will show the percentage of the substances of varying size held in suspension in the liquid, and thus the composition of the soil.

In practice it is sufficient to place the suspension in a calibrated cylinder, to take small samples at a given depth and at fixed intervals of time, and to measure the percentage of solid substances contained in each sample. These figures are then transferred on to a system of coordinates, where the abscissae correspond to the percentages of the solid substances, and the ordinates to the time, or better to the falling velocity, or better still to the logarithms of these velocities.

The following is an example: in the graph (Fig. 79) the ordinates 5-3 are logarithms of the velocities expressed in centimetres to the second power thus to log 5 there corresponds a velocity of 0.00001 to the second power, etc. The ordinates A-F (shown by lines at given distances) correspond to the falling velocities of known substances clay, fine sand, etc. The abscissae measure the percentages of substances corresponding to the different falling velocities. Each ordinate represents the average

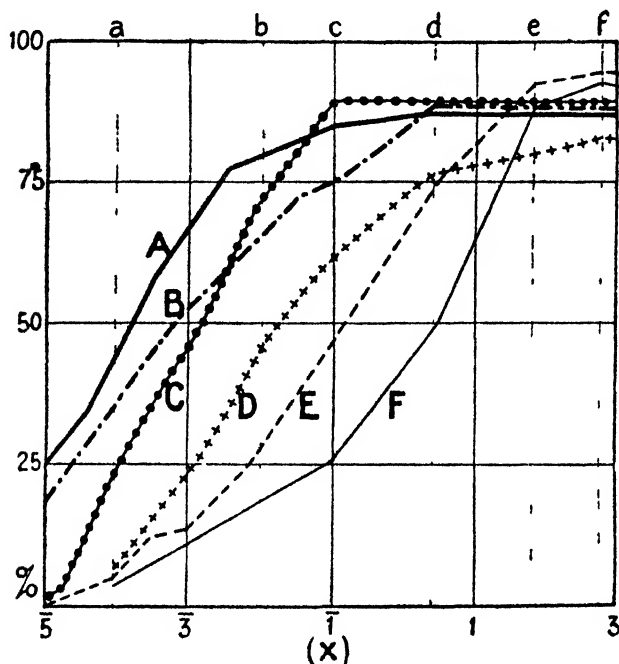


Fig. 79 Composition of typical soils
Abscissae logarithms of the velocities
Ordinates percentages

- A = Langold clay
- B = London clay
- C = Kaolin
- D = Alluvium
- E = Gravel
- F = Sandy clay

of the present and the preceding determinations added together if this were not so, in view of the varying nature of the composition of the soil, the construction of the graph would be impossible. Thus the kaolin submitted to experiment contains about 40 % of particles with a falling velocity lower than log 3, about 1.87 % with a falling velocity lower than log 1, and no particle of greater velocity.

This method is much quicker than the usual one, it admits of six analyses being made for each apparatus per day, and it is more economical, in so far as it does away with the use of sieves, filters, ovens, distilled water

and reagents. It is more exact, as it admits of graphic representation, which is far clearer than lists of figures. It has the further advantage that absolute accuracy is required in the investigations: an error of 1 mg in weighing is enough to introduce an error of 9.25 % in the results. It is advisable to note that high temperatures, due for example to the presence of stoves or radiators, must be avoided: an enquiry will have to be made later into the influence of temperature. L. V.

331. Some Investigations on the Electrical Method of Soil Moisture Determination.

DEIGHTON, T. (School of Agriculture, Cambridge). *The Journal of Agricultural Science*, Vol XII, Part 3, pp. 207-230, figs. 6, bibliography. Cambridge, 1922.

The author has measured electric conductivity *in situ*: the electrodes used were the carbon-points of electric arc-lamps. These carbon-points, which were 2 inches long and $\frac{3}{4}$ inch thick, were completely isolated except along a strip 1 inch in breadth near the paraboloid end. On burying the electrodes to a depth of 7 inches at a distance of 3 inches apart, the author was able, by means of many determinations, to trace the line of iso-resistance in a small plot of ground.

Electric resistance is connected not only with moisture, but also with other factors, such as the presence of electrolytes, and especially of nitrates.

From his observations of various substances in suspension, the author found differences in their behaviour when the amount of moisture was the same, this proves the influence of other factors, although in every case, there was a certain connection between the moisture and the electrical resistance, thus the resistance increases in inverse proportion to the square of the moisture if the moisture percentage is above 10 %, if it is lower, peaks occur in the logarithmic curves in the two opposite directions according to whether the matter in suspension contains colloidal substances, or not. The time factor also has an effect upon the results obtained.

The author refers to the work of other investigators on the same subject.

L. V.

332 The Practical Measurement of Soil Acidity,

HISSINK, D. J. Dr. Eenige opmerkingen over de beteekenis van het schatten van den zuurgrad van den grond dor en voor de practyk. *De Vel'bode*, No. 1066, pp 475-476 Maastricht, June 1923

The author, who is the Director of the Experiment Station of Groningen (Holland), has so far distributed to agriculturists, 250 "Comber" instruments for measuring soil acidity. The figures obtained with this instrument are not absolutely accurate, but serve for practical purposes, indeed, the measurements made by agriculturists and tested by the author in his laboratory have in several cases proved to be quite exact.

The object of the author in thus distributing the "Comber" apparatus was to obtain a large amount of statistical material. He wished to learn the differences in the reaction of the soil of the same plot according as to whether the plants were growing vigorously or less strongly, since this would show the correlation existing between the degree of soil acidity and crop growth, as well as the amount of acidity required in the case of a given type of soil in order to insure the maximum development of any particular cultivated crop. It is also necessary in this connection, to

take into account the situation of the fields, the fertiliser used, and the drainage.

The author gives an answer to the question put by many agriculturists who wished to know whether it was possible to determine by the Comber apparatus the amount of lime required for neutralising acid soils. The quantity of lime to be applied to acid soils depends, not only upon the degree of their acidity, but is also influenced by the amount of clay and humic substances present. In order to obtain accurate data, the author advises that the soil samples should be analysed in the laboratory.

The Comber method has, however, the advantage of enabling the agriculturist to know how many samples should be sent to the laboratory, which allows of the number being reduced and saves expense.

The author advises the regular testing of soil reaction, even after neutralisation, for it is always possible that some of the lime, or of the chemical fertilisers, may have been removed by water, or that their action may only be evident after several years.

By means of the Comber method (1) the agriculturist will always be able to decide for himself whether sulphate of ammonia is better for the soil than nitrate of soda and whether superphosphates or basic slag is the most suitable fertiliser in any given case

D. V S

333. Microbiological Analysis as an Index of Soil Fertility.

I. — WAKEMAN SELMAN, A The Influence of Reaction upon the Growth of Actinomycetes *Soil Science*, Vol XIV, No 1, pp 61-80 Baltimore, Md, 1922.

(1) The Comber method is described by the author in the *Journal of Agricultural Science*, 1920, p. 420. About 5 cc. of a colourless solution of 40 gm of sulphocyanide of potassium in a litre of 95 % alcohol are introduced into a test-tube containing 2-3 gm. of soil. The test tube is then corked and well shaken several times. As soon as the material in suspension has been deposited, the acidity as determined from the colour of the liquid.

Reaction	pH	Colour
Very acid	4-5	dark-red
Acid	about 5	red
Slightly acid	5-6	light-red
Very slightly acid	6-6.5	pale pink, or colourless
Traces of acid	6.5-7	Always colourless
Neutral	7	
Alkaline	above 7-6.5	

If the liquid remains colourless, some chloride of iron is added to colour the solution which is left for 18-24 hours and again shaken. If all the red coloration has disappeared, the soil will be about neutral (pH = 7); if however, the red tint is still clearly visible, the reaction will be slightly acid. In order to estimate the alkalinity, a series of solutions coloured with increasing amounts of chloride of iron are prepared. The more alkaline the soil, the more iron chloride it is able to absorb. (Ed.)

II. — IDEM. Microbiological Analysis of Soil as an Index of Soil Fertility: 1) Mathematical Interpretation of Results Obtained from Bacteriological Analysis of the Soil *Ibidem*, pp 81-101, 2) Methods of Study of Numbers of Microorganisms in the Soil. *Ibidem*, No. 3, pp. 283-298. 3) Influence of Fertilisation upon Numbers of Microorganisms in the Soil. *Ibidem*.

The author in the first paper reaches the following conclusions:

1) Results based upon a single soil sample are of no value. Several samples of the same soil (mixed if possible) should be used.

2) A sufficient number of plates must be employed (8-10 for each soil sample), in order that the most probable average error in calculating the number of microorganisms in each soil may be below 5 %

3) The number of bacteria and of actinomycetes alone should be determined by means of normal plates, for the estimation of hyphomycetes, it is necessary to employ special acids ($P^H = 4.0$) with dilutions $1/100$ of those used in estimating the total number of microorganisms.

4) It is necessary to have recourse to synthetic methods. The plates should be inoculated for 7 days at 27° - 28° C., or for 14 days at the temperature of the surrounding air, and all the colonies ought to be counted on each plate, the optimum being 50-200 colonies of microorganisms per plate. The only plates to be discarded are those with much growth of moulds.

5) By adopting these precautions, it was found that the application of fertilisers to a sandy soil not very rich in organic matter produced the following results:

a) Salts of potassium and phosphates stimulated the development of microorganisms, their effect being greater in the presence than in the absence of lime.

c) Nitrate of soda stimulated the development of the bacteria and actinomycetes, but not that of the hyphomycetes

d) Sulphate of ammonia, by making the soil distinctly acid, stimulated the development of the hyphomycetes, but produced a decided decrease in the number of the bacteria, and especially in that of the actinomycetes. When lime was added to the ammonium sulphate, the stimulating effect was equal to that shown by nitrate of soda

e) Stable-manure has a distinctly stimulating effect on all the groups of microorganisms that developed on the plate.

b) Production in the respective soils was almost parallel with the number of microorganisms present

The number of microorganisms in a soil, when determined under proper conditions, the variability of the method and soil being taken into account, may serve as a means of determining the bacteriological conditions and the fertility of the soil.

G. R.

334. *Microflora of the Polar Regions.*

BARTHEL, C Recherches bacteriologiques sur le Sol et sur les Matières fécales des animaux polaires du Groenland septentrional. *Den II Thule Ekspedition til Grønland Nordkyst*, 1916-18, No. 1. København, 1922.

Very few books have been written on the bacterial flora of the polar regions, and two alone (which refer solely to the Antarctic) deal with the

microbiology of the soil. To these latter must now be added the author's work which describes his researches on soil samples taken by Dr. Thorild WULFF on the Island of Disko, in the neighbourhood of Cape York, and during the second expedition of the "Thule" to the north coast of Greenland in 1917, conducted by Knud RASMUSSEN, that is to say, from completely unknown, virgin land.

The soil samples examined were 18 in number; of these 14 came from the Island of Disko and had been kept for 50 days, while 2 came from the region of Cape York, and 2 from the north coast of Greenland; they had been kept for about a year (at 45° C. below zero like the others). There were 8 samples of faeces, 5 from Cape York and 3 from the north coast Greenland; all of these had been kept for about one year. The animals to which they belonged were blue fox, Polar wolf, crow, seal, white bear, lemming, white partridge and *ovibos*.

From the Disko and North Greenland soil samples 19 species of bacteria were isolated, 2 of which could not be identified. The identified species are a *Tetracoccus*, *Sarcina flava*, *Bact. fluorescens*, *Bact. punctatum*, *Bact. lactis viscosum*, *Bact. violaceum*, *Bact. caudatum*, *Bact. umbilicatum*, *Bact. ochraceum*, *Bact. Zopfii*, *Bact. subtilis*, *Bact. mesentericus*, *Bact. malabarensis*, *Bact. asteriosporus*, *Bact. amylobacter*, *Bact. saccharobutyricus immobilis*, *Bact. putrificus*. In addition, some species were determined of the genera *Torula*, *Actinomyces*, *Oidium*, *Dematium* as well as of hyphomycetes.

Nitrate of potassium was found in almost all the soils and the presence of a living nitrifying organism in addition to that of denitrifying, ammonifying and uric bacteria was demonstrated. The almost constant occurrence of butyric ferments and of *B. asteriosporus* and *B. malabarensis* makes it most probable that these soils have the power of fixing nitrogen.

The faecal matter evacuated by Polar animals always contains different species of schizomycetes, *torulae*, actinomycetes and moulds. The author succeeded in isolating 20 of these organisms which have been identified as follows: *Micrococcus pyogenes albus*, *Micr. candidans*, *Micr. E.* (Barthel) *Sarcina flava*, *Streptococcus liquefaciens*, *Str. faecium*, *Str. bovis*, *Bact. subflavum*, *Bact. Pasteuri*, *Bact. subtilis*, *Bact. putrificus*, *Bact. saccharobutyricus immobilis*.

In the opinion of the author, the chief result of this work is that it gives proof of the ubiquity of the common bacteria of the soil and of those in the large intestine of warm-blooded animals which would seem to show that both on the north coast of Greenland, and in the European countries, organic matter is transformed by the same species of bacteria. G. R.

Fertilisers and Manures.

335 A Study of certain Preservatives and their Effect on the Fertilising Value of Manure.

COLLISON R. C., and CONN, H. J. New York Experimental Station, *Bulletin* No. 494, pp 26-74, figs. 21, pl. 6. Geneva, N. Y., 1922.

The value of manures produced on the farm has increased to such an extent that every precaution should be taken to conserve the contained

plant food-material. The authors have carried out a large number of experiments in order to study practical methods of treating manure so as to retain the plant food constituents. In the past, both mechanical and chemical methods have been recommended such as storing under cover and trampling down, or the addition of other materials, with a view to the prevention of loss of nitrogen caused by fermentation in the manure heap, or by leaching. Mechanical methods often necessitate extra labour and under ordinary conditions of farming it is usual to store manure for several months, hence, preservation by means of chemical agents assumes importance. An ideal chemical substance should prevent undesirable fermentative changes, but should not check the changes which break down the manurial compounds and make them available as plant food. If in addition, the added substance has a fertilising value of its own it is an advantage, provided that the cost is not too great. The authors experimented with the following materials: straw, peat, a clay-loam-soil, acid phosphate, rock phosphate and gypsum, and investigations were carried out with these materials under both laboratory and greenhouse conditions.

Allusion is made to the work of SEVERIN and of RUSSELL and RICHARDS and to the fact that the latter investigators found that the nitrogen losses were due to the volatilisation of elementary nitrogen, rather than to that of ammonia. SEVERIN isolated organisms from manure and used them to inoculate sterilised manure. The authors searched particularly for the organism concerned chiefly with the volatilisation of ammonia, and succeeded in isolating an organism *Bacterium parvulum* which reduces nitrate to nitrite and causes the evolution of large quantities of ammonia from manure. The laboratory experiments showed that loss of ammonia from manure may be prevented by the use of acid phosphate, peat or gypsum, for instance, the sterilised check lost only 3 mg nitrogen as ammonia, the unsterilised manure gave off 247 mg, when gypsum was added only 44.5 mg were given off, and with peat only 10 mg or very slightly more than the sterilised check. In this experiment no attention was paid to the loss of free nitrogen. It was shown that preservatives have an effect upon the kinds of micro-organisms present and may suppress those which cause ammonia volatilisation. The results obtained when straw was added to manure were interesting, as they suggest that nitrification may take place in manure.

Laboratory tests in themselves are insufficient, as the real test of a preservative is its ultimate effect on the fertilising effect of the manure, and for this reason compost experiments in the greenhouse were carried out.

For the greenhouse work manure was mixed with the preservatives and kept in a fairly moist condition under cover for three months or more. The composts were then used as sources of nitrogen for crops grown in sand cultures and in the greenhouse, other food elements being supplied by the addition of a mineral nutrient solution. The plants were harvested when the various cultures had reached about the same degree of maturity.

The data relative to these cultures are given below.

*Dry weight of tops and comparative tillering in barley cultures
in compost experiment No. 1, Culture Series No. 1.*

Source of nitrogen	Culture Number	Number of heads	Dry weight of tops
			Grams
Rotted manure	1	10	5.0
Rotted manure + NaNO ₃	2	26	60.5
Fresh manure	3	12	30.0
Fresh manure + NaNO ₃	4	33	61.0
Gypsum compost	5	12	8.5
Gypsum compost + NaNO ₃	6	22	58.5
Rotted manure + gypsum	7	11	5.5
Rotted manure + gypsum + NaNO ₃	8	25	63.5
Acid phosphate compost	9	9	10.5
Acid phosphate + compost + NaNO ₃	10	27	64.5
Rotted manure + acid phosphate	11	10	10.5
Rotted manure + acid phosphate + NaNO ₃	12	29	64.0
Rock phosphate compost	13	11	7.5
Rock phosphate compost + NaNO ₃	14	26	61.0
Rotted manure + rock phosphate	15	11	6.0
Rotted manure + rock phosphate + NaNO ₃	16	28	59.0
Peat compost	17	12	16.0
Peat compost + NaNO ₃	18	34	69.5
Rotted manure + peat	19	11	8.5
Rotted manure + peat + NaNO ₃	20	27	69.5
Straw compost	21	12	9.5
Straw compost + NaNO ₃	22	33	62.5
Rotted manure + straw	23	8	2.5
Rotted manure + straw + NaNO ₃	24	32	64.0
Soil compost	25	11	11.0
Soil compost + NaNO ₃	26	19	36.5
Rotted manure + soil	27	12	7.0
Rotted manure + soil + NaNO ₃	28	24	52.5

A second series of cultures were carried out in soil instead of sand, and a third series with composts, but containing four times the amount of compost used in Series 1 and 2.

Fresh manure gave a higher yield of barley dry tops than rotted manure or any compost, although the peat compost compared favorably. The addition of straw depressed the yield in every case except that of the manure-acid-phosphate-straw compost. When added to rotted manure the depression was 91 %, and it reached 58 % in the manure-peat compost ; further experiments are being made on this problem. In the vegetative experiments, acid phosphate composts gave the greatest weight of tops. Acid phosphate and peat both helped to retain inorganic nitrogen and apparently left the organic nitrogen in a condition more available to plants. The loss of dry matter on composts kept for four months ranged from 25 % on manure treated with acid phosphate to 63 % in untreated manure. Peat also was very efficient. Neither rock phosphate nor gypsum were satisfactory preservatives. The results of these experiments show that

both acid phosphate and peat may be recommended as preservatives of manure. The former involves least labour, but peat has the additional advantage that it is an excellent absorbent of the liquid portion of manure and in consequence acts both as a litter and a preservative. W. S. G.

336. An Ammonia Volatilising Organism found in Manure.

CONN, H. J. (Chief in Research on Soil Bacteriology) *New York Agricultural Experiment Station, Bulletin* No. 494, pp. 26-27. Geneva, N. Y., 1922.

The author in his investigations on bacteria involved in the ammonification of manure, found an organism, *Bacterium parvulum*, which seems to be a hitherto unknown form. The organism gives off from manure in pure culture and under laboratory conditions, amounts of ammonia equal to, or greater than, those obtained from unsterilised manure.

Bact. parvulum is a small, non sporing, Gram-negative rod, which does not liquify gelatin nor ferment sugars, but reduces nitrate to nitrite. It is strictly aerobic with an optimum growth temperature of about 25° C. Punctiform colonies are formed on gelatin, but the growth is small in liquid media.

The author's experiments are of interest in showing that a non-liquifying organism may be responsible for the volatilisation of large amounts of ammonia from manure, and that sterile manure inoculated with this organism may lose more nitrogen as ammonia than the same manure unsterilised. W. S. G.

337. Fertilising Value of Tapioca Refuse.

GEORGI, C. D. V. *The Malayan Agricultural Journal*, Vol. X, No. 8, p. 218. Kuala Lumpur, 1922.

An enquiry has been made as to the utilisation of refuse from tapioca factories as a fertiliser. This refuse is a greyish white powder containing a proportion of short fibres; the results of analysis are as follows: moisture 11.6; ash 28.7, organic and volatile matter (by difference) 59.7; nitrogen 0.61; potash 0.58; phosphoric acid 0.56%. Although this refuse would not pay for cost of transport, it could however be utilised to advantage *in situ*. M. L. Y.

338. The Composition of Kedah and Perlis Phosphates.

GREENSTREET, V. R. *Malayan Agricultural Journal*, Vol. XI, No. 3, pp. 70-71, Kuala Lumpur, 1923.

The article gives a description and also the analyses of a number of samples of phosphates received during the past two years. A study of the analyses shows that these phosphates vary greatly in their composition. The phosphoric acid content in Kedah phosphates varies from 12 to 31% and that of Perlis phosphates from 7 to 19%. The acid is combined with aluminium and iron, largely in the form of Wavellite (hy-

drated aluminium phosphate). One sample of Perlis phosphate contained a large excess of lime, whereas in all the other samples aluminium and iron predominated.

W. S. G.

339. **The Constitution of Basic Slag.**

SCOTT, A. and MCARTHUR, D. N. *Journal of the West of Scotland Iron and Steel Institute*, pp. 102-figs. 24, bibliography, Glasgow, 1922.

The work of the authors is a noteworthy contribution to the subject of Basic Slag and its constitution, and affords valuable information respecting phosphates. The paper contains the results of microscopic and chemical examinations of slags from both open hearth and Bessemer furnaces. A summary and brief description of previous literature is given, followed by the microscopic characters of the various slags examined and a discussion on the constituents and structures of the particular slags in relation to their chemical analyses. Twenty four reproductions from microscope slides are included.

Each slag was examined by reflected light from the ground and polished surface of specimens, also, thin sections were prepared and studied by transmitted light, while in some cases finely ground material was similarly investigated. The study of the structure of slags is difficult owing to their varied composition and the many forms of calcium and magnesium silicates, but the authors have collated much valuable information on the subject, which will be of great use to future investigators. W. S. G.

340 **The Effect of Potassic Fertilisers upon the Development and Chemical Composition of different Cultivated Plants.**

E. GODLEWSKI (Chef de division de chimie agricole at the State Institute of Rural Economy of Pulawy (Poland). *Comptes rendus des Séances de l'Académie d'Agriculture de France*, Vol IX, No. 14, pp 404-412 Paris, 1923

The soil of the Experiment Station of Cracow University being very deficient in assimilable potash led to the study of the effect of potash on the growth and chemical composition of different plants. The species used were as follows : garden bean, oats, potatoes, peas, mangels, lupin, ornithopus (Serradella), barley, rye and wheat. These plants were grown for several years on the same plots and also in rotation. From his experiments and the analyses made, the author draws the following principal conclusions.

The dry matter of plants growing on a soil poor in potash contains a lower percentage of potash and a higher percentage of other nutrient substances than that of plants taken from a soil possessing a high potash content.

The differences in the composition of the seeds are slight, but the straw composition varies greatly. The effect of an abundance, or lack, of potash in the soil is more marked upon the seed composition of oats and garden beans than upon that of the other cereals or leguminosae. Deficiency of potash produces scarcely any change in the normal lime and magnesium content of the seeds.

The amount of assimilable potash in the soil is, however, very clearly seen by the straw composition of all cereals and legumes. The potash content may range from 0.5 to 2 % of the dry matter.

A lack of assimilable potash in the soil induces a great change in the proportion $K_2O : CaO : MgO$ in the dry matter of the straw. This proportion varies from 100 : (55 to 120) : (16 to 37) and in the case of a high potash content : 100 : (23 to 28) : (7 to 9). The differences between the straw composition of various cereals are not great. The percentage of lime and magnesium present in legume straw is double that found in cereal straw. The differences due to want of potash in the soil are more marked in the case of legumes than in that of cereals.

Want of potash in the soil is also shown in kitchen-garden plants by the chemical composition of the dry matter of the reserve organs and of the leaves. A decrease in potash is accompanied by an increase in the other nutritive substances. Potato tubers are a remarkable exception as regards their magnesium content, but the amount of nitrogen they contain increases with the decrease in potash.

In the author's experiments, the bean, beetroot, potato and pea were the plants acting most upon the potassic fertiliser. Of the cereals, barley and wheat reacted more strongly than rye and oats. When a plant is cultivated on the same plot, its reaction on the potassic fertiliser is greater than when it is grown in rotation.

The same plant does not obtain the same advantage from the potassic fertiliser every year.

The unequal reaction of various plants upon the potassic fertiliser may be due to three causes.

1) Different plants under normal conditions assimilate different amounts of potash. Kitchen garden plants assimilate much more of this substance than cereals and legumes

2) Different plants have an unequal power of absorbing the slightly soluble form of potash present in the minerals of arable soil. The greatest power of absorbing potash is found in mangels grown in rotation, and the lowest in garden-beans.

3) Different plants do not utilise potash to the same extent in the formation of organic matter. Kitchen-garden plants produce less organic matter with a given amount of potash than legumes and cereals. Therefore, although they have a great capacity for potash assimilation, kitchen-garden plants require a much greater quantity of potash. Rye uses little potassic fertiliser partly because it has a great power of absorbing slightly soluble potash. When there is a deficiency of available potash in the soil, the other nutritive elements absorbed by the plants are used in a less economical manner than when the plants have an abundant supply of potash at their disposal, so that sometimes a smaller crop will absorb the same, or a greater, amount of nutritive substances than a larger crop grown on a soil rich in potash.

D. V. S.

341. Composition and Fertilising Value of Wood Ash and other Ashes.

BLACKSHAW, G. N. (Chief Chemist, Department of Agriculture, Rhodesia). *Bulletin No. 447*, pp. 1-4. Salisbury, Rhodesia, 1923.

In countries where, owing to cost of transport, it is not possible to purchase potash fertilisers a valuable substitute may be found in wood and other ashes. The author gives the analyses of several ashes, *e. g.*

Sunflower ash, from the stalks, leaves and heads of sunflowers after removal of the seed: potash 20.9 %, phosphoric oxide 0.98, lime 12.0.

Veldt Hay ash; potash 0.86 %, phosphoric oxide 0.85, lime 2.68.

Attention is drawn to the necessity to protect the ash from exposure to rain, owing to the solubility of the potash, also to the different fertilising value of plant ashes, as shown by the above examples. W. S. G.

Agricultural Botany.

342. Plants of Economic Value introduced into Egypt.

FORBES, R. *Sultanic Agricultural Society, Technical Section, Bulletin No. 10*, pp. 1-64. Cairo, 1923.

Out of about 800 plants introduced into Egypt, chiefly from South West U. S. during the last four years, some 20 have proved of especial economic value, although several others of less importance have readily adapted themselves to the new conditions.

The author states that in many cases standard Egyptian varieties and European importations have been grown in comparison with American introductions, and individual plants are described with sufficient detail to afford an understanding of the comparative merits of the varieties tried.

The twenty cultural successes of more or less economic value include:—

1) *Alfalfa, Harry Peruvian* (From Arizona). It appears that this variety produces a greater weight of forage than the native "ber-sim hegazi".

2) *Common Arizona Barley*. Very rust resistant and superior to the Wisconsin Pedigreed No. 6 (Arizona) liable to rust etc.; yield of grain equal to Egyptian varieties on good land; superior straw yield; later than the native variety.

3) Beans: *Moki White Lima* bean — well suited to a wide range of climatic and soil conditions, and to several crop rotations; very drought resistant and sets seed readily under arid conditions; of value in dry farming; immune to rust and insect pests.

Red Moki Limas (No. 50) sets its seed under more arid climatic conditions than other varieties.

Kidney beans (*Phaseolus vulgaris*); the Lady Washington and Colorado Pinto, the latter employed as a dry-farming crop in South-Western U. S. A., show adaptation to arid climatic conditions in Upper Egypt. None of the introduced varieties were found rust resistant, and compare unfavourably with already established varieties.

4) Cabbage. American market cabbages are small-headed compared with the native variety, but have given good results owing to the fact that they do not sprout with the advent of the hot weather and consequently are found on the market later.

According to the 1920-21 report, the Danish Ballhead and Winningstadt varieties weighed the most.

5) Cauliflower. Produced seed readily under Egyptian conditions and equal in weight to native variety (Vars. Dry Weather, Autumn Giant and Early Snowball).

6) Chili (*Capsicum annum*). The Anaheim variety has done especially well.

7) Cowpeas (*Vigna sinensis*; *V. Catjang*). The "Blackeye" although liable to rust, produces a seed crop of superior appearance and "New Era" proved rust resistant and a very productive early variety. Both these varieties are considered preferable to the native type.

8) Darso (*Sorghum*) has an advantage over the millets commonly grown in Upper Egypt, as it makes a second growth of heads for forage after the heads are cut.

9) Lettuce. *New York Market* proved the best of 10 introduced American varieties; compact heads of excellent flavour; superior in yield and quality to native varieties but liable to deteriorate rapidly under Egyptian conditions, consequently necessary to import seed each year.

10) Maize varieties: — White Rice Popcorn (*Zea everta*) and Papago Sweet Corn (*Zea saccharata*) have given satisfactory results. Out of 52 varieties of field maize from Australia, South Africa and United States, choice has been made during two years of culture, of 8 most promising varieties for final trial. — viz. North Dakota White, Silver King, Gurney's Model Dent, Silvermine, Italian, Boone County White, Reid's Yellow Dent, Sacaton June.

11) Oats — *Texas Red* rust resistant and good yield of grain to straw, matures later and somewhat inferior yield to native crop.

12) Gourds. — Summer squashes (*Cucurbita maxima*) compared well with pumpkin trials.

13) *Sesbania macrocarpa*, quick growing annual of distinct value as green manure, not successful as a fibre

Swedish Hairy Winter Vetch (*Vicia villosa*) — possibilities as a cover crop and soil binder — a spontaneous tuberculous species.

Tepary Beans (*Phaseolus acutifolius* var. *acutifolius*) (from S. Arizona and N. W. Mexico). Well adapted to arid climate and will set seed under conditions too hot and dry for ordinary kidney beans — possible value as cover, forage and green manure in Upper Egypt and the Sudan.

Tomatoes. The "Earliana" variety from U. S. A. proved the best out of 30 introduced varieties and is distinctly superior to the native variety, as regards smoothness, percentage of flesh to fruit, appearance, etc. It should replace other varieties in Egyptian markets.

The author gives details concerning several cultural successes of little apparent economic value, and also of decided failures due to lack

of acclimatisation, etc. The latter include. — cantaloupes, cassavas, cucumbers, pumpkins, water melons, peanuts, Swedish gore tares (*Vicia sativa*), and American wheats (unable to withstand rust attack) :

A comparison of climatic conditions in Egypt and Southwest U. S. is made and results generally indicate the reaction of differences of humidity, temperature, insolation, character of soil, etc. upon an introduced plant

M. L. Y.

343. Synopsis of the Species of the Genus *Morus*.

KOIDZUMI, G. Synopsis Specierum Generis Mori. *Bulletin of the Imperial Sericultural Experiment Station Japan*, Vol II, No 1, pp. 1-45, plates XI, Tokyo, 1923

The Monograph on the genus *Morus* by Ed. BUREAU, published, in 1873 (Vol XVII of Alph De CANDOLLE's "Prodromus Systematis Naturalis Regni Vegetabilis" was generally accepted and followed for some 40 years and almost all the forms of mulberries were erroneously treated by Japanese botanists, being referred to as "*Morus alba* Linn. and *M. indica* Linn.

A study of a large collection of mulberries at the Japanese Imperial Sericulture Experimental Station, Tokyo, has led the author to present a different interpretation of some of the forms, introducing radical changes in the nomenclature of the most common Japanese forms, and modifications in the classification of others. In 1917 these alterations were embodied in an article published by the author in the *Tokyo Botanical Magazine*, Vol. XXXI, pp. 35-41, entitled "the Enumeration of all the Known Species of the genus *Morus*", and also in the "Sangio-Shikengo Hokoku" (*Bulletin of the Sericultural Experiment Station*), Vol III, No 1, 1917, dealing with the "Taxonomy and Phytogeography of the genus *Morus* Linn.". The present paper is an enlargement of the section on the taxonomy of mulberries and consists mainly of a description and illustrations of the species known to the author as occurring wild or cultivated in Japan, Sachalin, Formosa, Korea and in the Loochoo Islands

The species are divided into two Sections:

- 1) *Dolichostylæ* (Style elongated and distinct)
- 2) *Macromorus* (without style, 2 stigmas, sessile).

The first section includes: *Morus arabica*, Koidz, *M. mongolica* C. K. Schneider, with var. *diabolica* Koidz and var. *vestita*, Rehder.; *M. nigiformis* Koidz; *M. notabilis* C. K. Schn., *M. bombycis*, Koidz.; with var. *caudatifolia* Koidz var. *humilis* Koidz. new var. *aphananthoides*, Koidz., s. var. *declinata* Koidz var. *lanceifolia* Koidz. var. *vestita*, Koidz. var. *squarrosodentata*, Koidz and var. *maritima* Koidz.; *M. rotundilob* Koidz.; *M. actidosa*, Griffith and var. *glabra* and *M. Kagayamae*, Koidz.

Section II includes: — « *serrata* Roxb; *M. nigra* Linn.; *M. tiliæfolia* Makino; *M. cathayana* Hemsl.; *M. mesozygia* Stapf. *M. laevigata* Wall.; *M. insignis* Bur *M. macroura* Miq.; *M. rubra* Linn.; *M. mollis* Rusby; *M. celtidifolia* Kuntz.; *M. boninensis*, Koidz; *M. microphylla*, Buekl.; *M. multicaulis* Perr. with var. *planifolia* Sering.; *M. alba* Linn.

with var. *pendula* Dippel and var. *argutidens*, Koidz.; *M. atropurpurea*, Roxb. A full botanical description is given of each species in Latin, followed by a list of 31 additional species and considered as synonymous with other species, indicated in each case; a list of 5 doubtful species: *M. australis* Poirét; *M. Cavallerii* Leveillé; *M. insularis*, Sprengel, *M. integrifolia*, Leveillé and Variot.; and *M. leucophylla* Miquel; a list of 9 species unknown to the author; a list of 13 species of uncertain origin; an index to all the species and varieties mentioned in this paper; an index to the Japanese popular names and an index to the Chinese nomenclature.

F. D.

344. Description of the *Brachystegia* spp. and their Economic Value.

BURTT DAVY, J. and HUTCHINSON, J. *Royal Botanic Gardens, Kew. Bulletin of Miscellaneous Information*, No. 4, pp. 129-163. London, 1923.

The textile and tanning value of the bark of certain *Brachystegia* species has already been recognised, but hitherto no complete enumeration and description of the various species has been compiled. The authors have supplied therefore the lacking information and the article contains a detailed review of the distribution, full key to the botanical characteristics of 54 species, soil requirements, propagation, general features of the forest and the economic value. The genus *Brachystegia* is confined to Equatorial Africa, the majority of species being found on the great plateau between Angola and Nyasaland.

USES. — Reports of the value of the bark have been received and the following species are known to be of distinct economic value.

For making good cloth: *B. Boehmii*, *B. Woodiana*, *B. Randii* and *Berlinia globiflora* of Tanganyika Territory, Nyasaland and Rhodesia; *B. longifolia* and *B. utilis* of Nyasaland, *B. Bragaei* of Rhodesia and Portuguese Africa. *B. edulis* of Kenya, Tanganyika and Rhodesia; *Berlinia Baimii* of Angola and *Ficus natalensis*, Uganda to Natal.

For making cord: *B. Boehmii*, *B. Bragaei*, *B. edulis*, *B. filiformis*, *B. Randii*, *B. tamarindoides*, *B. utilis* and *Berlinia globifera*.

For tanning purposes: *B. spicaeformis* Sini (probably *B. Bragaei* or *B. Brandii*) of Portuguese East Africa, 18 % tannin. *B. tamarindoides*, *B. utilis* of Katanga.

OTHER USES: — Medicinal value: *B. mpalensis* of Katanga and N. W. Rhodesia; river craft: *B. Allenii*, *B. tamarindoides*, and *B. Woodiana*; timber (for constructive purposes): *B. palensis* (of excellent quality). Other species are used for rafters, and fuel, and the possible utilisation for charcoal, wood distillation products and paper pulp is considered worth investigation; manufacture of water baskets (see SIM T. R. Forest Flora and Forest Resources East Africa).

Edible seeds: *B. edulis*; fodder: — *B. Woodiana*.

It is of interest to note that species are found growing on thin shale and quartzite soils, too poor for many other forest trees. This, combined with the fact that seed is readily obtainable, and the trees reproduce freely, are important economic factors in the problem of afforestation of tropical soils of poor quality.

M. L. Y.

345. Relation of Temperature to Blossoming in the Apple and Peach.

BRADFORD, F. C. *University of Missouri College of Agriculture, Agricultural Experiment Station. Research Bulletin* 53, p. 51, plates 5, tables 14, bibliography. Columbia Missouri, 1922.

Observations on the phenology of fruit trees in North America. The stage of development of the buds in the autumn has an influence on time of blossoming. It appears that late blossoming is connected with rest period influences rather than with differential temperature requirements.

Coefficients of correlation between heat accumulation and date of first blossoms on apple and peach trees are given, also variations in blossoming of several different varieties, etc.

These observations indicate that thermal constant conception may furnish a valuable basis for study of the response of plants to some of the factors associated with climate.

M. L. V.

346. The Mosquito-Destroying Power of Algae Belonging to the Genus *Chara*.

PARDO, L. Observaciones acerca de la acción de la *Chara* sobre las larvas de los mosquitos. *Boletín de la Real Sociedad española de Historia natural*, Vol. XXIII, No. 3, pp. 154-157 Madrid, 1923.

As a result of his study of Prof. CABALLERO's work (1919) on the effect of *Chara foetida* upon the larvae of the genera *Stegomyia*, *Culex* and *Anopheles*, the author was induced to visit the swamp zone of Onteniente (Valencia). Here he found, in close proximity to ponds swarming with mosquito-larvae, a single large pool which, although the water was very rarely renewed, proved entirely free from these pests. The bottom of the pool was thickly covered with *Chara hispida*, a plant that as Prof. MOROTE had also discovered, differs from other kinds of *Chara* in being able to thrive at a depth of over 3 m., which is a matter of great importance when it is necessary to destroy larvae in very deep water. These observations were completed by laboratory experiments. Some specimens of *Chara hispida* were planted at the bottom of a large glass jar into which, as soon as the plants had grown strongly (July 26), 6 *Stegomyia* larvae were introduced; 3 of these insects died after 2 days, 2 succumbed on the third day and the last in the fourth day. Three of the strongest *Stegomyia* larvae (which were shortly about to pupate) were left in the glass-jar which served as a vivarium for the mosquitoes, and some *Chara* plants were introduced; three days later, 2 of the larvae died and the next day the survivor perished. In similar experiments conducted by Prof. CABALLERO with *Chara foetida* the larvae did not die so soon, nor were they all killed; it would therefore appear that the larvicidal action of *C. hispida* is stronger than that of *C. foetida*.

The author describes in conclusion various observations made in the Botanic Gardens of Madrid which confirm the preceding statements; he further draws attention to the fact that the hemp retting-ponds in the neighbourhood of Valencia contain a thick growth of *C. hispida* and are entirely free from mosquito larvae.

E. P. C.

*Plant Breeding.***347. The Use and Value of Back-Crosses in Small-Grain Breeding.**

HARLAN, H. N. and POPE, M. N., *The Journal of Heredity*, Vol. XII, No. 7, pp. 319-322. Washington, 1922.

Hitherto the back-crosses of the F_1 progeny with the parent have been used almost exclusively to explain the laws of inheritance of plant characteristics, without any attempt to apply in practice the results already obtained in animal breeding, to fix desired characters in livestock.

The results obtained with smooth-awned barley are very promising. The rough awns are objectionable both in harvesting the crop and in feeding the straw. Considered from the practical standpoint, the cross Manchuria \times Lion results in a barley possessing all the desirable characteristics of Manchuria in addition to the single attraction of the Lion, namely the smooth-awned factor.

The difficulties of breeding on ordinary lines, with a view to fixing this character in F_2 , are insurmountable, for example, there would be just one chance in 1 048 576 that the 20 desirable Manchuria characters would be found in any segregate, and one chance in four that this segregate would be smooth-awned.

In back-crossing, however, if the 20 characters are inherited independently there is a rapid elimination of those coming from the Lion parent. With each recross the Lion "blood" is reduced one half; in 5 back matings only $1/64$ of the blood is not Manchuria and that $1/64$ is heterozygous with only one chance in 128 of any factor being finally other than Manchuria. If there were 20 independently inherited factors it is estimated that 108 out of 128 plants would be entirely homozygous for Manchuria characters and the remaining 20 would be heterozygous for only a single character. At this point it should be possible to select the plant desired.

G. A.

348 The Inheritance of Glume-Length in a Wheat Cross.

ENGLEDOW, F. L. *Journal of Genetics*, Vol. 13, No. 1, pp. 79-100. Cambridge, March 1923.

In some cases, two phenomena are observed in the frequency distribution of biometric values in the F_2 of wheat crosses:

- 1) The presence of individuals possessing the character in question to a higher degree than their parents;
- 2) the presence of individuals in which the maximum and minimum values of the given quality are always inferior to the corresponding values in the parents.

Thus, the hybrid resulting from the cross Polish \times Kubanka has a maximum glume-length of 30.5 mm. in the F_2 , while the medium in the case of the Polish parent is 30.84 mm., therefore there must have been some shift in the negative direction (reduction).

Occurrences of this nature may be explained by the theory of multiple

factors. This hypothesis is too elastic to admit of rigorous experimental tests, though it is true that the number of factors and their individual power can be changed in an arbitrary fashion so as to give a fairly satisfactory explanation of the phenomena. On the other hand, an increase in the number of factors makes the analyses longer and more difficult; further, it is not out of place to observe as a prudent reservation that the results obtained by experiment in this field of research render probable rather than prove the existence of multiple factors.

There are also other analogous cases that might be explained in a different manner. CASTLE, in his much discussed work on rats, suggested "the modification of unit characters by selection", while GATES maintained that after crossing, "gametic purity was not always to be expected".

In the case of Polish \times Kubanka, the use of multiple factors to explain the above-mentioned shift presents considerable difficulty.

The author has had recourse to the hypotheses that: 1) there is a principal factor A and a secondary factor B; 2) possibly the number of the factors and the combinations of factors have been increased by "adding", or "multiplicating", factors, but in no case, has he been able to exactly explain the observed facts.

The negative shifting of the length value of the glume might be due to the effect of the constitution of the maternal parent upon the development of the zygote, so that the F_2 P plants derived from plants of the F_1 I (individuals of the first generation with intermediate characters), would be poorer as compared with genetically identical zygotes derived from F_0 P (Polish type). This impoverishment might certainly show itself in a negative shift of the length values in the F_2 . When an F_1 individual is self-fertilised, one of its zygotes has the same genetic constitution as the zygotes of the F_0 P parent (long-glumed Polish). The zygote formed on the F_0 I is, however, nourished by a plant differing in genetic composition from the F_1 P parent and of much reduced dimensions. It is not impossible that a zygote with the factor composition F_0 P may show imperfect development because the maternal parent (in this case F_1 I), differs from F_0 P, and hence produces inferior, "shifted" individuals. An F_2 P population composed of such individuals would have an average glume-length below that of the line F_0 P. G. A.

349. Crosses between *Triticum* and *Aegilops*.

BLARINGHEM, L. Nouveaux faits relatifs aux hybrides de Blés et d'Aegilops. *Comptes rendus Hebdomadaires des Séances de l'Académie des Sciences*, Vol 176, No 12, pp 852-854. Paris, 1923.

The author has succeeded in obtaining viable hybrids by fertilising *Aegilops ovata* and *Ae. ventricosa* with the pollen of *Triticum monococcum*, *T. vulgare* and *T. Spelta*. In 1920, there were found in thirty flowers of *Ae. ovata* and *Ae. ventricosa*, that had been fertilised with pollen from *T. monococcum* L., 4 grains one of which germinated and produced a vigorous but completely sterile individual resembling *Aegilops speltoides*. It is worth noting that nearly all the ovules of *Ae. ventricosa* were success-

fully fertilized by means of pollen from a hybrid, *Monococcum* \times *durum*, fixed in 1911 and cultivated ever since. Twenty flowers on four different plants were pollinated, the total number of kernels produced being 13. These caryopsids were all short and inflated except two that were flattened like *ventricosa*.

The largest kernel ($5.5 \times 3 \times 2.5$) weighed 32 mgm. and the smallest ($3 \times 3 \times 1.5$) 5 mgm., the weight of all the kernels together was 270 mgm. These grains were normal and their colour, shape and weight clearly showed their hybrid origin (Xenia). G. A.

350 The Dissociation of the Barley Hybrid, Smooth-Awned Black \times Rough Awned Albert.

COLIN, H and TROUARD-RIOLLE, V Dissociation de l'hybride, orge noir \times à barbes lisses \times orge Albert *Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences* Vol 176, No. 12, pp 854-856 Paris, 1923.

This report gives an account of the results of a cross between white, rough-awned Albert barley and smooth-awned, black barley. The characters rough and black have hitherto been regarded as dominants in such cases, so that the F_1 should consist of black, rough-awned individuals. The author however found very little homogeneity in the first hybrid generation, taken as a whole. The character black, is dominant and in the entire F_1 , no single well-developed white grain was to be detected. On the other hand there were black, grey and white awns, a single ear often shewing both black and white awns. As regards roughness, some of the ears in the F_1 , had smooth awns only, others had smooth awns and rough awns, while in others again, the awns were smooth for half their length and rough for the remainder.

There is no correlation between colour and roughness

In the F_2 , the seed from the smooth-awned ears, whatever their colour, produced smooth-awned grey or black ears as if segregation had taken place in the F_1 .

Only the seed of the rough-awned ears showed any sign of Mendelian segregation, the follow new typical combinations being distinguished

Black ears	rough	smooth	smooth-rough
Grey ears	rough	smooth	smooth-rough
White ears	rough	smooth	smooth-rough

In addition to these well-defined types, all possible transitional forms were also present

Contrary to what would have occurred had the black and the rough characters been dominants in the true sense of the word, with close correspondence to the laws of Mendel, segregation phenomena thus made their appearance in the F_1 , whereas in the F_2 , there was a predominance of black and smooth and flattened ears, and the normal Mendelian combinations occurred combined with a large number of other forms and combinations.

G. A.

351. **An Abnormal Character in Barley.**

HARLAN H. N. and POPE M. N. Many-Noded, Dwarf Barley. *The Journal of Heredity*, Vol. XIII, No. 6, pp. 269-273. Washington, 1923.

In 1918, at Aberdeen, Idaho, in a sowing of barley Mesa, C. I., No. 1313. (*Hordeum distichon nudum*) a single plant was discovered which differed from the rest in having short culms (total length of plant 50 cm.) somewhat ramified towards the base. many slender leaves and abnormal or badly-developed, ears.

It was only possible to obtain seed from one of these abnormal ears which was less aberrant than the others. The plants raised from this seed, although varying considerably in culm length, retained the previously mentioned fundamental characters.

Crossing experiments made by the author with the varieties Baku (*Hordeum distichon, nudum*), Manchuria (*H. vulgare pallidum*), Utah Winter (*H. v. p. pyramidatum*) and Nepal (*H. v. trifurcatum*), have shown that the anomalies, described and determined by the author are due to a Mendelian simple recessive factor.

A. G.

352. **The Question of the Transmissibility of the Characters, Presence or Absence of Stringiness in the pods of *Phaseolus Vulgaris*.**

WELLENSIEK, S. Y. De Erfelijkheid van het al of niet Bezit van " Draad " by Rassen van *Phaseolus vulgaris* L. *Genetica*, Vol. IV, No. 5-6, pp 443-446. The Hague, November 1922.

The three non-stringy varieties of *Phaseolus vulgaris*, Hinrich's " Marble Giant ", " Volger " and non stringy Chocolate-brown, were fertilized with pollen of the Wagenaar variety, which is decidedly stringy.

In the F_1 the lack of stringiness is dominant, in the F_2 the proportions of a monohybrid are found.

G. A.

353. **Anomalies in the Transmission of the Character " Colour of the Embryos " in the Pea.**

BLARINGHEM, L. Héredité anormale de la couleur des embryons d'une variété de Pois (*Pisum sativum*, L.) *Comptes Rendus des Séances de l'Académie des Sciences*, No. 13, pp. 875-879. Paris, 1922.

In the classical experiments of MENDEL the yellow colour in the embryos of *Pisum sativum* is dominant over the green and hence in F_2 the proportion is 3 yellow to 1 green. In practice results are not always so simple and regular. In 1913 in the case of 18 plants of the variety " Pariser Gold " (*Pisum sativum* var. *axiphium*) one was noted which in addition to 27 normal yellowish seeds produced 2 yellow-green seeds. In 1914 the plants from the yellow and green seeds produced respectively yellow and green seeds. The greens were replanted in 1919 and then gave 11 plants with pale green embryos, while in 1920 out of 28 plants there were 25 which has only green embryos (lines 911-919) while the remaining 3 (lines

921-923) gave respectively 17, 12 and 10 green and 5-4 and 11 yellow embryos respectively.

In 1921 the experimental tests were carried out on a large scale. The yellow embryos of lines 921-923 gave yellow embryos, with only the exception of a single plant with 15 yellow and one marked with green. The green descendants of the same lines were distinguished as follows:

921:	24	yellow;	28	green,	95	intermediate	=	137
922:	15	"	32	"	117	"	=	164
923:	21	"	28	"	40	"	=	88

For the line 923 there are roughly 3 green for 1 yellow which is the complete reverse of the normal case. In addition other quite unexpected features are to be remarked. For example: a plant of line 917 gave yellow seeds for the 2 lower pods and green seeds for the 3 higher pods. It seems therefore quite impossible to trace any scheme of separation in the mendelian sense even after taking into account the presence of several independent genetic factors.

Other students have already called attention to similar cases, WHITE for the influence of climate, and ZEDERBAUER for the influence of age on the exhibition of characteristics: young specimens which are ordinarily recessive tend after crossing with more adult individuals to assume the position of true dominants.

In conclusion it may be stated that certain lines of *Pisum sativum* show great irregularities in the transmission of characters, irregularities which make necessary a strict choice of the lines to which alone they remain constant. On the other hand the irregular lines provide material which can be utilised in the estimation of the action of the environment, age and the special conditions of the crossing upon the exhibition of characteristics.

G. A.

354. Morphological Characters Used in Flax Selection.

BLARINGHEM, L., Etudes sur la sélection du lin. *Revue de Botanique appliquée et d'Agriculture Coloniale*, Year 3, No. 17, pp. 3-26, figs. 3, tables 2. Paris, 1923.

In cultivated flax (*Linum usitatissimum* L.) the reproductive organs are arranged in the manner characteristic of self-fertilising plants, the stamens reach the height of the stigmata by the time the latter are almost mature and cover them liberally with pollen. *Linum angustifolium* has also a similar marked tendency to self-pollination. Further, when emasculated, these two species cross without difficulty, in every possible combination and their hybrids produce fertile seed. The sexual organs mature in the same manner in both species. The author draws attention to the extreme sensibility to all mutilation shown by the young sexual organs of the flax plant. If emasculation is effected during the three days preceding flowering, abortion of the capsules is the almost inevitable result, while the premature removal of the anthers arrests the development of the ovary. There is a critical period in the development of the flax

flower, which takes place about the time when the bud attains a quarter of its maximum length. This sensibility is a function of the climate and of meteorological factors. Light especially has a very strong effect; flax buds even when entire and not emasculated, if bagged too early, abort in large numbers. The dependence of the reproductive organs upon external factors appears to be acquired when the buds have attained half the total length they reach the morning before the flower opens. During the morning of that day self-fertilisation takes place, but it never lasts more than two hours, the germination of the pollen grains at once begins and by the next morning the ovary has already assumed its globular form.

Upon these peculiarities in the pollination of cultivated species of flax rests the whole problem of the separation of pure pedigree lines. It is necessary to know whether the homogamy of the flaxes grown is sufficiently marked and constant in order to be sure that cross-fertilisation is only accidental and therefore does not affect the question of preserving the seed. *A priori* it would appear not to be a matter of frequent occurrence.

The flax flowers are visited by insects, but they rarely touch the pollen and never collect it since their object is the nectar. Indeed, because nectar is their only aim, accidental cross-fertilisation is very rare in cultivated flax plants, but the danger of its occurrence is not wholly excluded. The persistence of nectaries in *L. usitatissimum* shows that this species is exposed to the danger of cross-fertilisation by insects. Further, only selection and constant supervision of the lines can give any real guarantees of stability.

The author chose as type-lines suited for studies of heredity and crossing only those forms in which the stigmata at the time the flower opened were thickly covered with a mass of pollen from the stamens of the same flower. He rejected any line having one, or two flowers bearing a withered or unopened anther, and also made a very minute study of the pollens in order to find some rule of homogeneity for subsequent use in fibre-flax selection based on the percentage of abortive pollen grains (1).

It is well-known that plants obtained by crossing are most vigorous when their sexual organs are least perfect, therefore the selection of the flaxes with longest fibres means the choice of those with defective reproductive organs. It may well be that the degeneration taking place in Russian flaxes when transported to Western Europe is due to this correlation, since cold climates are favourable to homogamy and temperate climates to dichogamy.

After describing the characters of a good fibre flax, the author points out that these clearly depend upon stem growth, and the same line does

(1) See L. BLARINGHEM Sur le pollen du Lin et la dégénérescence des variétés cultivées pour la fibre. *Comptes rendus Acad. des Sciences*, Vol. 172, pp. 1603, 1921, R. November 1921, No. 1106. (Ed.)

not produce fibre of the same kind every year. On the other hand, it must be recognised that a flax producing much tow may give a very low yield of industrial fibre, whereas long fibres may be obtained from a flax with little tow. Before beginning selection, it is therefore necessary to take into account the qualities required for any given centre of flax-growing.

In the problem studied by the author there are two essential and distinct questions to be considered :

1) Are there any grounds for expecting that a seed of flax possessed of the required characters will be able to transmit these characters for a sufficient number of generations to render seed production profitable? In other words, is the degeneracy of the Russian flaxes capable of being lessened or prevented? The author has already expressed his opinion to the effect that Russian flaxes are mixtures of hybrids and of fixed lines. This he tested with one type *E. G. B. K.* which after cultivation for 4 generations in France, remained as fixed as the most stable lines grown for seed production.

Experiments made on French and foreign flaxes cultivated for fibre showed that each group consisted of easily separated fixed lines and hybrid lines. Practically the only way in which the problem can be solved is by applying this knowledge to flax-growing on a large scale.

2) Can these pure lines produce the quality of fibre required by the the industry after they have been grown in certain centres? It is probable that definite types will be found yielding excellent results in one or another centre, but time would be saved and pure line testing made easier if growers for the flax trade would confine their efforts to the selection and cultivation of only two, or three, types.

In his search for control characters (purity of type) and selection characters (corresponding to the increase or decrease of a quality), the author has turned his attention to the colour of the flowers, the colour of the seed and the type of the capsules.

a) *Colour of flowers.* — Miss TINE TAMMES (1) has proved that as regards the colour and size of the petals, there are at least 8 independent factors which act in more or less complete correlation with the colour of the anthers and of the seeds. The seed colour depends partly upon a factor that intensifies the pink of the stamens and petals. On the other hand, seeds of a yellow colour incline to a greenish shade when the factor producing curling of the petals and a yellowish colour in the anthers is present. The latter characters are associated with somewhat pronounced abortion of the pollen, therefore the aim of selection must be to eliminate them. The author intends to confine his work to the selection of flaxes with white flowers and brown seeds.

b) *Colour of the seeds.* — This furnishes a series of terms for prac-

(1) TINE TAMMES. Genetic Analyses, Schemes of Co-operation and Multiple Allelomorphs, *Linum usitatissimum*. *Journal of Genetics*, Vol. 12, pp. 19-46, 1922.

tical comparison. Seed-colour, however, appears to be independent of the other characters of the plant. Thus, although in the first test of the purity of the seed the colour of the episperm may be taken as an indication, it is not an infallible guide.

c) *Capsules*. — A test analysis of the pure origin of fibre flaxes must include an examination of the capsules, if well-founded, indisputable guarantees are required. This process, it is true, interferes with the sale of the seed, and when it is a question of selected seed, the seed-coat is best left until just before sowing.

The author subsequently studies the significance in each type of the variation in the height of the stalks, the size of the fruit clusters, the length of the peduncles of the first fruits, the distance between the sepals of the ripe fruit, the shape of the fruits, the number of seeds per fruit, the relative width of the false dissepiments and the shape of the seeds, all of which characters were measured, or used as a basis for classification into different categories.

The shape of the seeds gives accurate information in the case of seed-flaxes, but is of no value in that of fibre-flaxes, owing to the very variable percentage of aborted seeds.

For the controlling of line purity there is one character that can be relied upon as marking the origin of the seed, this is the presence, or absence, of the small hairs bordering the edge of the false dissepiment turned towards the axis of the fruit. These processes are very stable and are nearly always independent of the other characters of the lines studied. Out of all the cultivated flaxes examined by the author only the Morocco and the white seeded varieties proved pure as regards these hairs, all the others showing evidence of much impurity. In order to preserve the purity of his varieties of flax, the grower need only take two precautions: he must sow the pure seed after carefully cleaning the sacks, seeders, etc., that are used, and at harvest time should clean separately, and as far as possible on the field itself, the plants that have been pulled up with sufficiently ripe seed to be used for sowing.

From 1918 to 1922, the author noted several kinds of seed-flaxes which proved to be quite useless for the production of commercial fibre, but owing to their great regularity of growth, are types eminently suited for the study of the chances of cross fertilisation and the analysis of the characters of pollen as affected by the age of the flowers and changes of climate.

The same fixity is nearly always met with in *Bombay flax* but some lines have shown certain irregularities of growth, these are however regarded by the author, as recent hybrids, although he has not yet proved this point. *White Seeded flax* grows with extreme regularity and never produces hairs, regular growth is the best character to select for analysing fibre flaxes.

On the other hand, the progeny of fibre-flaxes show great irregularity; only in the lot *E. B. G. R.* are hairs always present together with true homogeneity in the pollen and the maturation of the fruits.

R. D.

355 Selection of Coconuts.

JACK, H. W. (Economic Botanist, Department of Agriculture, F. M. S. and S. S.). *Malayan Agricultural Journal*, Vol. X, No. 5, pp. 122-127. Kuala Lumpur, 1922.

The use of coconut oil and vegetable oils in general, have increased to such an extent that the quantity of copra exported from the Federated Malay States has grown from 16 404 piculs (1 picul = 133 lb. apx) in 1904, to 419 988 piculs in 1920. The importance of increasing the yield per tree is evident and selection and breeding experiments have been started in South India, the Philippines, Java and the Federated Malay States. The chief character of economic importance is that of copra production, and the number of nuts given by a tree is not a reliable index, owing to the variation in size of the nuts, thickness of meat, etc

A study was made of 453 trees and it was found that the yield of nuts per annum varied from 7 to 180, also, selected nuts were planted in half-acre test plots and there are indications that at least 10 % of the daughter trees do not come true to type.

It is suggested that 40 acre blocks in the best areas of estates should be chosen for selection of seed nuts, and that all trees in that block should be numbered and the yield in nuts recorded. The amounts of dry copra from the nuts of each tree should then be ascertained. Note should be made of the environment of the best trees as they may be in favoured situations. It should be possible to find in a block of 40 acres, 100 trees yielding fully 110 nuts per annum. The production of pure strains of coconuts has recently been undertaken by the Department of Agriculture. The type of nut to select appears to be a medium sized, round coconut.

The Chemical Division has carried out experiments with a view to the selection of types of nuts by means of the quality of the contained oil, but results do not show that the oils obtained from the different types vary to any appreciable degree.

The Botanical Division has collected seed-nuts from 18 local varieties and has imported seednuts from Borneo, Java, Ceylon, Seychelles, South India, Cocos Islands, Panama, Burma and Madagascar. These have been planted in the Government Experimental Coconut Estate, which, it is hoped will be able to do much during the next few years to solve some of the problems connected with this crop.

W. S. G.

356 Chestnut Hybrids (*Castanea japonica* × *C. americana*).

DETLEFSEN, J. A. and RUTH, W. A. An Orchard of Chestnut Hybrids. *The Journal of Heredity*, Vol. XIII, No. 7, pp. 305-310, figs. 5. Washington, July, 1923.

The authors give a description of the Japanese chestnut *Castanea japonica* and the American chestnut (*C. americana*) respectively, as well as of the hybrids resulting from a cross between the two species.

The Japanese chestnut has the advantage of bearing large fruits that are easily separated from the cupule which is relatively small; further it is resistant to the weevil (*Balaninus* sp.), and flowers and ripens its

[355-356]

fruit early. The nuts have fewer prickles and are of a better colour than those of the American chestnut.

C. Americana bears three small nuts in each cupule to which they adhere tightly. They are less attractive in colour, but have thinner skins and the cupule has more prickles. The quality of the pulp is finer. The tree grows rapidly and vigorously whereas *C. japonica* has a habit resembling that of a fruit-tree.

The objects of the cross were to unite in a single type the good qualities of both parents and to eliminate the negative characters.

In the F_1 , three plants were obtained called Blair, Boon and Riehl. The first two produced three chestnuts in each cupule (like their American parent) but the cupule of the third only contained one well-developed nut, the two others having remained small and abortive.

In vigour of growth, productivity and early bearing (at the fourth or fifth year), the hybrids were clearly superior to both their parents.

Of the three F_1 individuals, "Boon" took the first place for vigour, early bearing, and the quality and quantity of the crop. From it EN-DICOTT obtained 175 seed plants hoping that thus would produce a stock of equally valuable trees.

The results of the F_2 were quite different from what had been expected. Owing to segregation, the hybrids were far from homogeneous, some trees 14 years of age only reached the height of $2\frac{1}{2}$ metres, while others in their neighbourhood grew to 7 metres. Further, none of the F_2 hybrids were as vigorous, fertile and productive as those of the F_1 . They did not bear fruit until between the fifth and eighth year. The chestnuts ripened from the beginning of September until the middle of October with individual variations forming a series of intermediate values connecting the extreme parental types.

The size of the fruits also offered clear proof of segregation; the Boon chestnuts were intermediate between those of the two parents, whereas F_2 some of the trees bore fruits as small as those of the American Chestnut, while others produced fine large nuts like *C. japonicum*, all the intermediate dimensions being also represented. Similar variations were also observed in the case of the prickles and other characters.

The behaviour of the F_2 suggests the possibility of multiple factors being concerned in the transmission of the characters in question.

An attempt was made to propagate vegetatively (by means of grafting) the valuable properties of the F_1 , it, however, proved unsuccessful, as the grafts did not take.

G. A.

Seeds

357. Physiological Studies on the Action of Formaldehyde on Wheat.

ATWOOD, W. M. (Oregon Experiment Station). *The Botanical Gazette*, Vol XXIV, No 3, pp. 233-263, figs. 12, bibliography of 58 works. Chicago, Ill., 1922.

Hitherto, the injurious action of formaldehyde has been estimated from the results of germination tests, but these are probably not suffi-

cient evidence, for as STEPHENS has found, the vitality of the seeds is lowered, therefore though they may germinate, they will produce less vigorous plants. The author has consequently carried out some direct tests for the purpose of determining, not only the germinative capacity of seeds treated with formaldehyde, but also the effect of the latter upon the respiration and the diastatic and catalytic action of the plant. In these experiments, commercial formalin containing 40 % (or more accurately, 39.3 %) in volume of gaseous formaldehyde was used. The dilutions that will be mentioned all refer to this solution.

Germinating capacity — Formalin diluted to 1 : 320 was allowed to act for a time varying from 5 to 300 minutes, after which the seeds were placed to germinate on damp blotting-paper, or planted in the ground; in the latter case, a certain number were kept in the laboratory. Nearly all the seeds on the blotting paper germinated, but a larger or smaller number of those planted in the ground perished, especially when the formaldehyde treatment was prolonged beyond 30 minutes, the toxic action was more marked in the seeds that had been planted out-of-doors than in the case of those kept in the laboratory. Oats had already been reported by CRANFIELD to behave in the same way; this was subsequently confirmed. WALDEN gives the following explanation of the greater mortality among the seedlings growing out-of-doors. The formaldehyde injures the hypocotyl, which has difficulty in overcoming the resistance of the soil, therefore the seedlings growing in the ground die very easily. Other experiments have been made in which the concentration of the formalin varied from 1 : 320 to 1 : 40; the length of treatment being in every case 10 minutes, and the temperature 20° C. A rapid fall in germinating capacity was observed as soon as the concentration was higher than 1 : 160.

The author has also experimented with the polymers of formaldehyde, substances easily obtained by the action of low temperatures, concentration, or drying. These compounds have not yet been individualised and pass under the generic name of paraformaldehydes. An unsuccessful attempt was made to hinder their formation. Spraying with paraformaldehyde has proved to be extremely injurious, more than 90 % of the seeds having been killed by this means, a result confirming the previous observations of COONS and MCKINNEY and of Miss HURD.

Permeability. — This was ascertained by the author who fixed some isolated seeds at the bottom of test-tubes (using glue for the purpose) and filled the tubes with a formalin solution. After 3-4 days, the projecting part of the seed was cut off and treated with SCHRYVER's formaldehyde reagent. The formalin was found to penetrate into the seed when the concentration was sufficiently high *e. g.* 1 : 8.

The author has also carried out an indirect test based on the work of BROWN, who demonstrated that the seeds immersed in a solution behave differently according to whether their integument is permeable or semi-permeable, that is, whether the solution can, or cannot, reach the seed itself. Thus, when the external osmotic pressure is less than the internal osmotic pressure, and the seed has a permeable integument,

the seed continues to imbibe the solution slowly, until an equilibrium between the two osmotic forces is reached, and therefore its weight undergoes no alteration. If on the other hand, the integument allows the substances in solution to pass through it, the increase in weight is rapid and the curve denoting it quickly becomes flattened. If pure water is substituted for the solution, the seed only loses some of its weight when the integument is permeable; in this manner, an inversion of the curve is produced. This characteristic behaviour is shown by seeds of wheat in the presence of formaldehyde as can be seen by reference to Fig. 80 which gives the results of a test carried out in triplicate, with a 1 : 8 formalin solution on samples of 3.5 gm. for 292 hours. The inversions of the two curves denote the passage of the seeds from formalin solution into water and *vice-versa*. This test

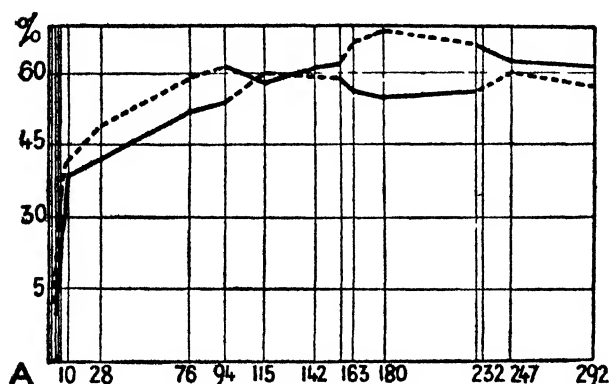


FIG. 80 — Variation of weight of seed wheat plunged alternately in water and in 1 : 8 formalin.

A = hours.

Continuous lines (1) = Immersions in formalin.

Broken lines (2) = " " water

shows that formaldehyde does penetrate into wheat grains, although slowly and with difficulty. The permeability of wheat grain by formaldehyde acquires a special significance in the light of the researches of COLLINS, which prove that the substances in solution are diffused within the seed through the embryo; this explains the considerable injury produced, even when the penetration is slow and difficult.

Diastasic activity. — The author has studied the action of formaldehyde on the saccharification of soluble starch effected by the diastasic ferment (diastase Merck). All the experiments were in duplicate; the heights of the columns give the amount of starch still undigested after 1 $\frac{1}{4}$ hour at 40° C. It is found that pure formalin (at 1 : 1 and 1 : 10) completely arrests digestion and neutralises the action of diastase. At lower concentrations, formalin only hinders saccharification, as has been shown from the fact that the operation took place, after 65-6 hours, in almost all the tubes.

The author has conducted other experiments directly on seeds. These were treated with formalin at different concentrations (from 1 : 320 to 1 : 80). The seeds were left to drain for 2 hours in a current of hot air, dried, ground and extracted. The extract obtained was added in amounts varying from 5 to 20 cm³, to soluble starch. After an hour, the digestion

was seen to be more or less retarded, as compared with the controls (extract of seeds immersed in water) in which the process was already complete. The arresting action was especially noticeable in the case of strong concentrations.

Respiratory activity. — Respiratory exchange is a fundamental vital process, for which reason the author has made it the subject of many careful investigations. These he carried out according to the usual methods, on 160 lots of seeds some being placed in water and others in formalin solutions of various concentrations for 10 minutes. The carbon dioxide was estimated with barium hydrate. The experiment lasted for some hours.

It was found that the respiratory activity of the latter seeds was considerably reduced, as compared with that of the controls, when the concentration of the formalin used was 1 : 80, but while the depressing influence was still noticeable down to 1 : 320, it practically ceased at concentrations of 1 : 400 and 1 : 1,000; therefore the 1 : 320 solution commonly used is very near the innocuous limit. Owing to the excessive growth of *Rhizopus* due to the hot, dry air of the respirometer, the author was unable to extend his experiments to the seedlings.

Oxydising capacity. — Formaldehyde reduced the capacity of the seeds for liberating the oxygen present in oxygenated water. This is well shown in a graph, where the heights of the columns give the cc. of oxygen liberated by extracts of the seeds at 28° C. When the correction for pressure is made, and the weight of the seeds is reckoned at 1 gm., the various lots are found to behave almost identically.

These researches show that formalin in the usual concentration of 1 : 320 only slightly reduces the germinating capacity of wheat seeds but it perceptibly hinders their diastasic power, depresses respiratory exchange, and hinders their catalytic action. It is probable that the sum of its effects is to *reduce vitality*, even in the seeds that retain their power of germination.

It would be well to extend these experiments to the above mentioned proteolytic processes, and to determine the effect of the immunising treatment and subsequent washing proposed by BROWN and HURD as the best means of preserving the physiological activity of seeds dressed with formaldehyde and of militating against the injurious effects of this treatment.

L. V.

358. Modern Seed Testing : The New Zealand Official Seed Station.

FOY, N. R. (Biological Laboratory, Wellington). *The New Zealand Journal of Agriculture*, Vol XXVI, No 2, pp 65-72. Wellington, 1923.

The author mentions the work carried out at the principal seed stations throughout the world with special reference to the two leading stations at Zurich and Copenhagen. This is followed by a detailed description of the system adopted in New Zealand by the Official Seed Station in collaboration with the Biological Laboratory of the Department of Agriculture. Two recognised methods have been tried, the Continental and

the Irish but up to the present the latter method has been found more economical and practicable.

Germination tests are made in 3 specially constructed germinators :

1) the all-metal water bath type (enclosed on all sides by a water jacket), used for the testing of more difficult seeds such as rye grass cocksfoot, dogstail and fescue ; 2) the glass wooden-frame type for all clovers, cruciferae, cereals, peas and vegetables ; 3) the small water bath type, for paspalum, *Poa* species, etc. where a high temperature is required. With the exception of paspalum, and *Poa* species (95° to 65° F) cereals at ordinary room temperatures and peas 75° to 60° F, all seeds are germinated at a temperature from 85° to 65° F subsequently rising to 85° for 8 hours, and then the temperature lowered to 65° for the remaining 16 hours.

Peas and beans are soaked in water for 16 hours before placing in the germinator, damp sawdust being used for the beans. Four counts are made of each sample, the intervals allowed vary according to the class of seed under test ; the number germinated is entered on the record card.

In the purity analysis the percentage of extraneous seeds is given by weight.

After the second germination count, a report is forwarded to the sender of the seeds stating the average germination after a specified number of days, and the percentage of impurities. This facilitates discrimination as to the ultimate value of the species and the interim report also gives a good indication of the vitality of the type. The final report at the close of the testing period registers the intermediate and final germination, each after a certain fixed number of days, and in the case of purity tests, the percentage of extraneous seeds and a complete list of the impurities.

Any peculiarity noted about the sample, such as the presence of mites, etc. is also reported, allowances are also made for hard seed coats common with clover seeds.

In addition to germination and purity tests, research is being made relative to seed storage, loss of vitality and improved methods of testing.

M. L. Y.

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D. V. S.

360. HAMED, MAHMUD (Inspector, Physical Department, Cairo). Experiments with Evaporimeters. *Cairo Scientific Journal*, Vol. XI, No. 108, pp. 10-14, figs. 2. Cairo, 1923.

The *Piche* and *Wild* evaporimeters are described, and details given of experiments carried out to ascertain the influence of edge evaporation on the accuracy of results.

W. S. G.

361. HENDRICK, J. (University of Aberdeen). Fertilisers before and after the War Reprinted from *Transactions of the Highland and Agricultural Society of Scotland*, p. 22. Edinburgh, 1922.

Professor HENDRICK reviews the position of the fertiliser industry from the year 1840 to the present time. He alludes to the dye and drug industries and points out that these do not give employment to more than a fraction of the labour required in the manufacture of fertilisers. Attention is drawn to the importance of the synthetic process for fixation of nitrogen. He considers that owing to competition amongst producers fertilisers will be cheap, also, that the variety is now greater than before and in consequence the farmer requires more knowledge respecting fertilisers and their uses.

W S G.

362. GILCHRIST, P S, Trend of Modern Fertiliser Plant Construction *Industrial and Engineering Chemistry*, Vol. 15, No. 1, pp 86-87 Washington, 1923.

A detailed description of the construction and manipulation of a modern fertiliser plant.

D. V. S.

363. BALY, E E C. (Liverpool University). The Growth of Plants. *Chemistry and Industry*, Vol. 42, No. 11, pp. 256-258. London, 1923

Discussion relative to plant growth and the influence of light on the chemical reactions.

D. V. S.

364. WODARZ, K. (Aus dem Agrikulturchemischen und Bacteriologischen Institut der Schlesischen Friedrich-Wilhelm Universität zur Breslau). Changes in Beetroots and Beetroot Leaves when Stored in the Field. Untersuchungen zur Frage der Umsetzungen in auf dem Felde lagernden Rubenblätter und Köpfen. *Zeitschrift des Vereins der Deutschen Zucker-Industrie* No. 804, pp 2-27, bibliography of 24 works. Berlin, 1923.

An account of chemical investigations on the changes taking place in beetroot leaves and roots when stored on the field.

D. V. S.

365. LESAGE, P Action comparée de la sylvinite et de ses composants sur les premiers développements de plantes. — *Comptes Rendus de l'Académie des Sciences*, Vol. 175, n. 25, pp 992-995. Paris, 1922.

Comparative experiments on the action of sylvinite and its components on the early of plant growth.

Dr. S.

366. CHARLTON, J. (Agricultural Chemist, Burma). The Determination of Prussic Acid in Burma (*Phaseolus lunatus*). *Bulletins Issued by the Agricultural Research Institute, Pusa*, Bulletin No. 140, pp. 1-7. Calcutta, 1923.

The author gives the prussic acid content of Burma beans (*Phaseolus lunatus*).

D. V. S.

367. BOERNER, E. G. (In charge of Grain Investigations) and ROYER, E. H. (Specialist in Grain Investigations). The Test Weight of Grain: a simple method of determining the accuracy of the testing apparatus. *Bulletin No 1065*, United States Department of Agriculture, p. 13, figs 8. Washington, 1922.

The "test weight per bushel" is one of the chief factors in the grading of grain, hence it is essential that the "test weight" be accurately determined.

The authors describe the apparatus required for taking the test weight per bushel (1) also, variations and special points to observe in making correct weight-bushel tests. Methods are given for the determination of the accuracy of the test kettle and the sensitiveness of the beam of the balance. A table of equivalents is given and its use explained

W. S. G.

CROPS OF TEMPERATE AND TROPICAL COUNTRIES

(INCLUDING FORESTRY)

SYNTHETIC ARTICLES.

368 Crops and Vegetable Products in Kenya and Uganda.

GRAY, W. S. *Technical Adviser, International Institute of Agriculture, Rome* (2)

The countries of Kenya and Uganda lie immediately below the Equator but the climate is far from being uniformly tropical owing to the contour of this part of Africa. The land rises more or less steadily from the coast to the highlands, where on the western side of the Great Rift Valley the Mau escarpment attains an altitude of 9000 feet and then falls somewhat rapidly to 3600 feet on the shores of Victoria Nyanza and more slowly in passing from the south to the north of Uganda. As a result of this conformation the climate varies from purely tropical on the coast to almost that of a fine English summer in the extensive highland areas which are healthy and suitable for European settlers.

The annual rainfall varies from 25 to 75 inches according to the district and there are two rainy seasons, with the result that in many

(1) See B. 1917, No. 271. (Ed.)

(2) The material for this article was obtained during the author's residence in East Africa and as a result of visits to plantations and farms, supplemented by information from official sources. (Ed.)

parts of the country two crops can be harvested in one year from the same land.

There is probably a sufficiency of native labour but in Kenya most of the tribes are rather unintelligent and the average native dislikes any form of continuous labour ; hence a great deal of time is wasted in teaching new boys the rudiments of agriculture. These remarks apply to a much less degree in Uganda where the natives are generally of a higher type.

The question of environment and climate in relation to the development and yield of cultivated plants is now being studied by many investigators, and if the best results are to be obtained there must be a practical application by way of selection of the crops most suited to the weather and soil conditions of the particular district, for instance, flax is practically confined to the highlands of Kenya where there are deep, well drained soils and a heavy and well distributed rainfall may be expected. On the other hand the coconut palm is limited to the coastal belt and maize will thrive under widely differing conditions of climate and soil.

FIBRE CROPS. *Cotton* — This crop is very largely grown in Uganda at altitudes below 4000 ft and in districts where the difference between day and night temperatures are not too strongly marked. Owing to waterways and excellent roads internal transport is good, but at present the only outlet to the coast is by the Uganda Railway, a single track which is inadequate for the expansion of commerce until improvements are effected. This fact has a direct bearing on the development of all crops as there is often great delay of goods in transit and no certainty that products will reach the European markets promptly. Until means of transport are improved no great extension of the area under cotton can be expected. The best soils are deep, light, reddish loams with gravel subsoils. Most of the so-called black cotton soils are too retentive of moisture and are generally situated in areas where drainage is difficult. The varieties grown belong to the American long staple type, such as Allen, Sunflower and Nyasaland, the latter having been acclimatised in Nyasaland and introduced into Uganda a few years ago.

Almost the whole of Uganda under 4000 feet is suitable for cotton-growing but the soils are patchy, and large, homogeneous areas are difficult to find. Parts of the Buganda Eastern and Northern Provinces may be regarded as the most suitable districts ; the Eastern Province has the additional advantage of water transport on Lakes Kioga and Kwanaia. There is a considerable population and the native appears to have taken up cotton-growing seriously, but needs encouragement and instruction by the Government in modern methods of cultivation.

Cotton is grown exclusively by natives in small plots of $\frac{1}{4}$ to 1 acre and the product is sold in the public markets or to the ginneries. The yield is less than 300 lb. per acre, which is not satisfactory as on Government plantations under better methods of cultivation, over 400 lb. are obtained. The figures given below show the yields in 1921 from

one of the Experimental Farms under the control of the Department of Agriculture :—

	Yield	Staple
Var. Allen (No. 14).	445 lb lint per acre	1 $\frac{1}{4}$ inch
Var. Sunflower	458 " " " "	1 $\frac{8}{16}$ "
Var. Allen	494 " " " "	1 $\frac{8}{16}$ "

There are two seed Selection Stations in the Protectorate and a great deal of work is being done in connection with seed control and distribution and the instruction of the natives in modern agricultural methods.

The seed is sown and the young plants thinned out to a distance of about two feet. Planting takes place in the Eastern Province during June and July and picking begins in November. Picking is not well done by the natives generally: small pieces of broken leaf are gathered with the cotton and are very difficult to remove in ginning.

The crop does not offer much attraction to the white planter owing to the difficulty of obtaining and keeping up a sufficient supply of labour, in a country where the natives do not care for any permanent and continuous form of employment. No European could live on the proceeds from small plots, but would have to take up large areas, in which case the danger of outbreaks from pests and diseases would be considerable. Complaint is made as to taxation and the unrestricted granting of ginneries sites in districts already well served, the result being that ginneries are unable to work at their maximum capacity and therefore economically. A cheap form of power for ginning factories is obtained by distillation of cotton-seed and the production of power gas. In Egypt roller-gins are exclusively employed and turn out better quality lint, but in countries like Uganda where labour is less skilled saw gins find many advocates, as they are easy to keep in order, less costly for maintenance and give a much larger output. The average weight of a cotton bale in Uganda is 400 lb. and density 30 lb. per cubic foot.

As regards prospects of largely increased areas under cotton in Uganda, Kenya Colony and Tanganyika Territory, such increase will undoubtedly come, but it will be slow owing to the necessity for instructing the native in methods for cultivation, especially in Kenya and Tanganyika. It has been suggested that the white settler in Tanganyika Territory should grow his own cotton, but of reasons given above such a policy would be very hazardous, although the country has large areas suitable for the crop. There is an excellent district in the Kavirondo country of Kenya where soil, climate and labour are all apparently suitable for cotton growing.

FLAX (*Linum usitatissimum*) can be grown in temperate and sub-tropical countries but during the period of growth the temperature and rainfall conditions should not vary too widely or the plants will develop irregularly and the quality of the fibre will be affected. In Kenya there were in 1922 over 20 000 acres under flax and there are in the highlands large areas at altitudes of from 6000 to 8000 ft. where the soil is

deep and well-drained and climatic conditions suitable. The chief rainy season is from April to June and the lesser rains occur from September to November with a total fall of 50 to 80 inches, which makes it possible to pull two crops of flax in one year, and also extends the retting period over about seven months. A common fault with new settlers owing to their lack of agricultural knowledge, is to sow flax on newly-broken, badly cultivated land, and often they will not take advice, with the result that they obtain very uneven crops of low actual value. A well made, even seed-bed is essential, otherwise the seed will be buried at different depths, growth will be unequal and the resulting fibre will not be uniform. The selection of seed is a matter of great importance and only the best fibre strains should be bought; there is a quantity of seed in the country which is suitable for seed production only and not for fibre, and settlers would be well-advised to communicate with the Department of Agriculture before making local purchases. Seed imported from Europe is often found on arrival to have lost germinating power. The writer had occasion to test over 600 bags of flax seed which before leaving England had a germination capacity of 96 %, but soon after arrival in Africa was found to average 55 % only, with variations of from 89 % to 7 %. The matter was investigated and experiments indicated that in addition to the effects of heat or damp in transit, pressure is an important factor to be taken into account, this pressure is considerable in the case of bags lying under a heavy cargo in the lower part of the hold of a ship. Only very rough experiments could be carried out but the results led to the suggestion that all seed exported for sowing purposes should be packed in barrels instead of bags, as in this way the seed would be protected from both pressure and damp. A good sample should be plump and fairly uniform in colour and size. As regards the sowing itself, a drill is probably best but excellent results are obtained with the "fiddle", provided that the land is rolled before and after sowing. The young plant appears above-ground in 5 or 6 days and the flax is ready for pulling in about 4½ months. The quantity of seed required varies according to soil and climate, but about 85 lb per acre with seed of 95 % germination was found to be correct at an altitude of 7000 feet. In Ireland, flax is pulled when green, but in Kenya a loss of fibre will result if harvesting takes place at such an early stage. Water-retting has not hitherto proved very successful in East Africa, probably because many of the upland waters contain iron, which would be unfavourable to bacterial action. Dew-retting is usually preferred and is carried on during the rainy months, the process occupying about 20 days; long exposure to the sun lowers quality and gives the flax a reddish colour. African natives when trained make fairly good scutchers but as they will rarely work continuously for more than a few months, it is difficult to keep a factory supplied with skilled boys.

The yield is low when compared with that of Europe and the ratio of tow to flax is high, probably owing to inferior cultivation and lack of good scutchers and also to the effects of the tropical sun on the ret-

ting straw. The following figures show the yield from crops grown in 1920 and 1921 which came under the writer's notice:—

Flax Fibre = 2.45 cwt. per acre
Flax Tow = 1.23 " " "

The ratio of 2 : 1 compares favourably with that usually obtained in East Africa where the yield of tow is often equal to that of flax. The grade of the fibre is medium and the grade of the tow is high as a rule.

Contrary to experience in England the writer found, as a result of some experiments that phosphates had a marked effect on the crop, probably owing to a deficiency of this constituent in the soil.

The following diseases are met with:—

1) "Yellowing" or "Browning". *Asterocystis radialis*, which attacks young plants. The stems and leaves turn yellow and then brown and the plants have a scorched appearance. When small patches are noticed they should be burned at once, and if larger areas are affected flax should not be grown on that land for some years.

2) "Wilt" — due to *Fusarium lini*. Seed may be treated with a weak solution of formalin (1 : 300) in order to kill any spores. Land which is affected with wilt should be abandoned for flax growing.

When estimating the quality of a sample of flax the following points should be noted: Colour and uniformity, weight, length, silkiness and fineness and general cleanliness. The appointment by the Government of official graders was a step in the right direction, as it is essential to standardise a product if the best market prices are to be obtained. It is greatly to be regretted that owing to the necessity for economy on the part of the Government this grading is to be discontinued, as complaints have been made as to the want of uniformity in Kenya flax consignments, which such a system would soon remedy.

OIL EXTRACTION. — Comparatively little use is made of a large proportion of the flax seed, apart from that required for sowing, on account of the high cost of transport and the absence of large oil mills in the country. Such mills must be on a sufficiently large scale to allow of economical management and should then prove to be a profitable investment. To ensure success the interests of the grower of the seed and the owner of the mill must be identical and a cooperatively owned mill would be a very effective means to this end. Both Kenya and Uganda produce a great variety of oil-seeds, including sim-sim (*Sesamum*) ground-nuts (*Arachis*) and the castor-oil plant (*Ricinus* sp.) which grows wild in many parts.

The yield of oil depends upon the seed and also upon the method of extraction which in the case of linseed is as follows:—

Extraction	by Solvents	about 32 % of weight of seed
"	" Hot Press method	" 27 % " " "
"	" Cold " "	" 20 % " " "

The Hot Press method would probably be the most suitable as the solvent process requires the use of volatile and expensive liquids such

as ether and a technical staff. If a convenient unit be taken such as 5000 acres under flax grown for fibre, after allowing for seed requirements, the yield would be somewhat as under:—

5000 acres flax yield	1000 tons linseed
1000 tons linseed "	270 " oil
and residue of cattle cake.	700 "

If the flax were grown for seed only and a seed variety chosen, the yield would be at least double and the output of oil and cake would be in proportion. Further, the same mill could be adapted for the expression of oil from seed other than flax seed, and lubricating oils might be manufactured, in which case the Uganda Railway would be an important local customer.

SISAL, (*Agave sisalana*). — Sisal hemp cultivation has proved to be one of the most successful of Kenya's industries and in 1920 it was grown on more than 30 000 acres.

Sisal is often considered to be a crop for poor dry land, and some of the finest fibre is produced near Mombasa on rough, stony soil which appears to consist of little more than sand and coral, however, when grown on better soil in the highlands the yield is heavier and labour is also cheaper, thus counterbalancing the increased cost of transport to the coast.

Sisal cannot be grown economically on a small scale owing to the cost of factory and plant, and in the selection of land consideration must be given to configuration, as tramways are usually laid for transport purposes; a good supply of water is also necessary for washing the fibre. The plant begins to give a return in from three to four years, after which leaves may continue to be cut for three years, during which time the yield should be about 1 ton of fibre per acre per annum.

The fibre is separated by crushing and scraping the leaves in a machine soon after cutting; the fibre is then well washed and dried in the open air. The fibres are from 3 ½ ft to 5 ft. in length and are yellow-white in colour and rather harsh to the touch. It is similar but inferior to Manila hemp for rope making, but has many other uses and will probably maintain its position as one of the most important of all fibre plants.

FOOD AND OTHER CROPS. COFFEE (*Coffea arabica*). — This crop occupies about 12 000 acres in Uganda and over 30 000 in Kenya, of which one half are in the Kikuyu district near Nairobi. One variety called "Nandi coffee" is found wild in the highlands. Coffee thrives at altitudes of from 4000 to 6500 feet, and on a variety of soils, provided that they are well drained. Forest land is generally suitable for plantations as the soil is often deep and rich and contains a high percentage of organic matter, which retains moisture, an important point in the case of a shallow rooted crop such as coffee.

Adequate capital is essential for coffee planting as there is practically no return until the fourth or fifth year, by which time not less than £15-£20 per acre will have been expended.

The selection of good seed is important as the shrubs bear for 40 or 50 years and carelessness in this respect will reduce profits over a long period.

The seeds germinate in about six weeks and the young seedlings should be ready for transplanting in from twelve to fifteen months; the distance between the plants depends on various conditions but 8×8 feet is usual, in which case about 600 plants will be required per acre. There are many small, but important details in connection with planting out for which the novice should get expert advice and assistance, among these are making the holes, preparing and filling in the soil, protection of the plants against cutworms, etc. Coffee shrubs thrive best in the shade of trees; the selection of the species will depend upon the locality but *Grevillea robusta*, a leguminous tree and a quick grower, is one of the best and can be used also as windbreak. The soil round the shrubs need not be kept bare, but grass is very harmful and must be destroyed. The fruit, or "cherry" is borne on new wood, hence the old wood is pruned away; some growers leave the top of the shrubs to form an "umbrella" which acts as a protection from hail. The yield per acre may be from 5 to 10 cwt., or even more, according to soil, altitude and season. After picking, the pulp is removed from the "cherries" by a simple machine and the "parchment coffee" is left for about eighteen hours to ferment in order to facilitate the removal of the mucilage which adheres to the berries. The berries are then washed and dried in the sun or in a mechanical dryer. The product is at this stage known as "parchment coffee", as each berry is still covered by a thin, tough, parchment like skin. The crop can be exported in this form, or sent to a curing factory to be peeled and polished by machinery. Whenever possible the coffee should be graded by an expert as in this way a higher price will be obtained on the London market. It is probable that in the future the estates will be grouped together in the form of Companies, which would tend to standardise the product and place the industry in a stronger position.

SUGAR CANE — This crop has been grown on a small scale only up to the present time, but developments are now taking place and in the vicinity of Kisumu a considerable area is being planted with cane, and there is every prospect of the establishment of a large industry in the near future. The Uba and striped Bamboo varieties seem to be the most successful but more experimental work is necessary in order to decide which varieties are best suited to the country. It has been shown that cane grown on high land is richer in sugar but lower in tonnage than that grown on low land. Fertilisers increase the tonnage but do not affect the sucrose content of the cane. The manufacture of commercial alcohol from molasses would form a valuable by-product industry. Ether is obtained from alcohol by distillation with sulphuric acid, and motor spirit, for which there would be a local market, consists mainly of a mixture of denatured alcohol and ether.

MAIZE is the most widely cultivated crop as it will grow under various climatic conditions and on almost all soils except clays. The crop will give a return in about four months at lower levels, but requires six

to seven months to mature at a height of 7000 ft. which is therefore about the limit for profitable cultivation. The yield varies from 40 up to even 80 bushels per acre. Maize is grown both by the native and the white settler and is the only cereal usually given to horses or cattle ; when ground it is known as " posho " and forms the staple food of the native. The white, flat varieties yield heavier crops than the round, yellow maize. The crop is easy and inexpensive to grow as the native understands its cultivation and there would be a large export trade if it were not for heavy railway rates. To obtain the best market prices consignments should be large, not less than 100 tons of the same grade, in fact, a whole cargo of bulk grain or charter would get an advantage as it could be diverted to any port. Kenya will never compete with South Africa as regards area under cereals, as the former country will grow many more valuable crops.

WHEAT has been successfully grown but only to the extent of about 5000 acres, probably because of the liability of the plant to attacks of rust (*Puccinia graminis*), which in 1920 reduced the average yield to 3 bushels per acre. In 1920 also the Department of Agriculture sent the writer some seed wheat from two rust-resistant varieties which had been bred at the Kabete Experimental Station near Nairobi. One acre of each was grown at an altitude of 6800 feet and only a trace of rust was found, and a similar result was obtained the next year. The average yield would be about 15 bushels per acre.

BARLEY grows well and does not appear to be much attacked by rust, and the yield is higher than that of wheat. There should be a ready market in South Africa for barley, if transport could be arranged.

TEA. — The highlands of Kenya offer conditions of rainfall and soil which in many respects resemble the tea districts of Ceylon. Small areas have been planted and the quality of the tea appears to be satisfactory. An experimental 8 acres which came under the writer's notice showed that the total cost from clearing the ground to the first plucking in the 4th year, would be about £25 per acre. The great difficulty with this crop would be to maintain a supply of trained and fairly intelligent labour for which the African natives are not so well adapted as the Indian.

CITRUS FRUITS are very suitable for the highlands where the soil is of light texture and where the rainfall is heavy. The crop can be grown for the expression of the juice as a beverage, or for the production of citric acid, or for the essential oil. A small crop may be picked in the third year but the bushes will not be in full bearing until they are six years old. The necessary acreage is small, say 50 to 75 acres, and the labour needed is much less than for some crops, but capital is required for the presses in addition to that which must be expended before the productive stage is reached.

TOBACCO (*Nicotiana tabacum*). — Some years ago the cultivation of tobacco was tried in Kenya but the quality of the leaf was not satisfactory and although a tobacco officer is on the staff of the Department of Agriculture and experiments have been carried out by the Government, few

settlers have given attention to the crop. The plant requires a soil of open texture and with a high percentage of potash; chlorine is detrimental; phosphates favour early maturity and a light coloured leaf; excess of nitrogen produces coarse, heavy dark leaves. The plants are grown from seed and transplanted when 8 to 10 weeks old and about five weeks later are topped by nipping off the flower-bud and leaving 10 or 12 leaves on the stem; when ripe the leaves are removed, tied in bundles of three and hung over sticks and allowed to wilt in the sun, after which they are taken to the drying-barn where they remain for 6 or 7 days in temperatures rising at regular intervals from 90° F to 160° F. A drying-barn of simple construction measuring 20 × 20 × 20 feet will deal with 3 ½ tons of wet leaf, the product of 2 acres. The dried leaves are then carefully stacked on a wooden floor and left for 6 or 8 weeks to ferment and mature; during this stage butyric and acetic acids are produced and ammonia is evolved. The alkaloid content increases from 0.25 % in the young plant to 4 % or more when full grown. When mature the leaves are graded and placed in bundles or "hands" of 13 or 25 leaves, ready for packing and export.

There are many other plant products to which reference might be made, such as coconuts, rubber, wattle-bark and flower growing for perfumes, but those already mentioned are sufficient to give some idea of the possibilities as regards vegetable products of the Central and East African parts of the British Empire. The chief requirements of these countries are improved means of transport, and instruction of the native in modern methods of agriculture. Adequate funds and facilities should be placed at the disposal of the Departments of Agriculture so that the resources of science may be brought to bear on the many problems, in the interests of increased crop production.

369. Studies on Tobacco Cultivation and Curing in Italy.

I. — BENINCASA, M., Kentucky gigante. Un nuovo ibrido di tabacco Kentucky. *Bollettino Tecnico del R Istituto Sperimentale per le coltivazioni dei tabacchi, Scafati (Salerno)*, Year XIX, Nos 3-4, pp. 191-194, figs. 2, Scafati, 1922.

II. — VISINTINI G. Alcune cifre sulla coltivazione del tabacco e lavori inerenti. *L'Istria agricola*, Year II, No. 14, Parenzo, 1922.

III. — Quanto può rendere il tabacco. Confronti col granturco e col lino. *Bollettino della Cattedra Ambulante di Agricoltura per la provincia di Bergamo*, Year XVII, No. 8. Bergamo, 1922.

IV. — DONADONI, M. La nuova cura sistema Angeloni per i tabacchi tipo Kentucky e similari. *Bollettino tecnico del R. Istituto Sperimentale per la coltivazione dei Tabacchi, Scafati (Salerno)*, Year XIX, No. 2, pp. 73-80.

V. — DONADONI, M. Sulla probabile uguaglianza di quattro percentuali nella cura a fuoco diretto, e a foglie staccate del tabacco Kentucky. *Ibidem*, Nos. 3-4, pp. 205-214.

VI. — BERNARDINI, L. Sulla perdita in nicotina dei tabacchi in funzione dell'umidità e del calore. *Ibidem*, pp. 215-230, diagrams 2.

VII. — NOVELLI, N. L'industria degli essiccatori e la tabacchicoltura. *Il Giornale di Riscoltura*, Vol. XIII, No. 2, pp 18-20. Vercelli, 1923.

I. — In 1913, BENINCASA began selection work with a view to obtaining a heavy type of tobacco with a yield superior to Kentucky and its various hybrids of the heavier kinds, as already cultivated in Italy. He obtained the desired result by pollinating a cross between "Salento" and "Erzegovina gigantea" with pollen from the hybrid "Salento" (*Nicotiana glauca*) and further selection. To the type thus obtained he gave the name of "Kentucky gigante". Since it produced a number of leaves which was excessive from the industrial standpoint, this hybrid was re-crossed with pure Kentucky, raised from seed from the United States. The new type bore larger and fewer leaves and was given the name of Kentucky gigante No. 2.

This tobacco has a very high yield; almost before the floral buds appear, the plants have reached the height of about 2.3 m. It is suited to hot climates and cool, fairly heavy, fertile soils. Good "Toscani" cigars of the fermented type are made from the leaves.

II. Prof. VISINTINI has made a series of estimates of the amount of labour required in tobacco cultivation.

Planting — In damp, loose soil without clods, 6 boys take 20 minutes to plant one plot of 4 rows each containing 250 plants; that is to say, a boy can put in about 500 plants an hour. In half-dried lumpy soil, recently watered, a boy will barely reach an average of 1880 plantings a day. It is too much to expect that a strong, expert man will plant 8000 seedlings, or a woman 6000 in an eight hours' day and 5000 is a very good average.

Gathering the leaves. — After a little instruction, 12 boys will gather 886 leaves per hour of the first crop (lower leaves) and 1088 of the second. The return, if women are employed, is less, the average being 722 leaves of the second crop per woman and per hour, as their movements are hindered by the sticky leaves which cling to their garments.

Sorting the leaves — The largest amount of work is done with the leaves of the second crop of the Erzegovina variety; 1633 leaves being picked per woman, and 1175 per boy, per hour.

Stringing the leaves — This is a operation especially suited to strong young women. A clever worker will thread 6000 leaves in 8 hours, but the average does not exceed 5000.

III. — From the data collected by the Brescia Travelling Professor of Agriculture, tobacco yields a higher gross and net return than any other crop. For purposes of comparison the two most profitable crops, maize, and flax were chosen.

The average production per hectare for the province is as follows: maize 36.8 quintals, flax 4.6 quintals of retted fibre and 7.7 quintals of seed; tobacco 15.3 quintals of leaves. Taking a moderate price standard (August 1922), the following estimates can be made; Maize 100 *lire* per quintal, flax-fibre 480 *lire* per quintal, linseed 190 *lire* per quintal; and tobacco 580 *lire* per quintal. Thus, the gross return per hectare for the

three crops is: 3680 *lire* from maize; 3681 *lire* from flax and 8874 *lire* from tobacco.

In the case of maize, it may be reckoned that a quarter of the crop goes to pay for the expenses of hoeing and harvesting; thus there remain 2760 *lire* for the owner who has to undertake the cost of working the ground, sowing and manuring.

In the case of flax, one-third of the produce suffices to pay for harvesting and handling, so that there remain about 2450 *lire* for the owner from which must be deducted the expenses of cultivation, manuring and sowing.

When tobacco is grown, the cultural operations, curing and sorting absorb one-third of the gross value of the produce. If reckoned at one-half to allow for the inexperience of novices in tobacco-growing, there is a balance of 4437 *lire* per hectare from which must be subtracted the expenses of working and manuring the land, etc. The profit is even higher, if it is remembered that tobacco may follow the second crop of hay and sometimes is even planted after wheat. A further advantage is that though tobacco cultivation requires more labour than the other crops there is always a large margin of profit.

IV — The new curing method devised by ANGELONI for tobaccos of a heavy type includes the following successive operations: gathering the leaves — yellowing — pressing — partial drying — removal of the veins — partial drying of the leaves after removal of the veins — mass fermentation.

Yellowing is obtained by a heating process (ANGELONI has improved upon the ordinary method) by hanging out the strings of leaves or suspending the whole plant ("scaffolding") The latter method is preferable (1).

The yellowed tobacco is passed into the cement presses where it is subjected to a uniform pressure for 24 hours. The leaves are then taken from the presses, spread out in the air to dry and then the veins are removed. The leaf fragments are again dried by being once more exposed to the air, or put into special desiccators and then kept for a day in the so-called refermentation receptacles (*panconcini*). Fermentation sets up in small masses that increase in volume after repeated turnings over. After two or three fermentations within a maximum period of 4 days, the required state of transformation is reached, the moisture content is then reduced to 25 % — slow fermentation takes place — the tobacco is made up into bundles and finally worked up.

With this system a workable product is obtained in ten days, but it cannot be rolled. Leaves for rolling must be specially selected for the

(1) This is confirmed by the work of Dr. L. BERNARDINI (*sul nuovo processo ANGELONI di cura e fermentazione dei tabacchi tipo Kentucky, Bollettino tecnico del R. Istituto Sperimentale, Scafati*, Vol. XIX, Nos 3-4, pp. 195-204, 1922), who has proved that spreading out the plants has the following advantages: 1) It is not necessary to dry the veinless leaf after pressing, provided its moisture does not exceed 50 %; 2) the development of the acid smell during fermentation and the consequent "fried" odour acquired in the manufacture are eliminated; 3) the fermented product has more substance and therefore keeps better.

purpose and either cured by the fire process, or by some modified form of the ANGELONI system. It is also necessary in this case to prolong the yellowing until the leaves begin to turn a brownish colour to limit the pressure, and to arrest the mass fermentation at the right point.

V. — DONADONI stated in 1912 that the weight of a tobacco of normal consistency *i. e.* a tobacco that has re-absorbed sufficient moisture after the curing to allow the leaves to be handled without danger of breaking, is very nearly the weight of the dry substance present in the same tobacco at the time the leaves were gathered. Afterwards, when working with Kentucky tobacco that had been cured after separating the leaves and by direct fire-heat, he found that in the average of a series of tests, the first of the two weights only exceeded the second by barely 0.5 % ; a difference that may be attributable to the loss of volatile substances during the drying up of the specimen used for the determination of the dry matter.

Hence it follows that : the percentage of dry substances present in tobacco leaves at the moment they are gathered should be the same as the percentage of the same substances in cured tobacco of normal consistency ; 2) the weight of the water in cured tobacco of normal consistency is equal to the weight of the dry matter lost during the curing process ; 3) the moisture percentage in cured tobacco is equal to the percentage of dry matter lost during the curing process.

In the experiments he made from 1912 to 1922, the author found the general averages (in 12 samples) of the 4 percentages : dry substance in green leaves — dry matter in tobacco of normal consistency — loss of dry matter — moisture in cured tobacco — to be respectively : 15.49 — 15.55 — 15.92 — 16.96 %. Owing to the inevitable errors in such calculations, these figures may be regarded as theoretically equal, and this equality has been intuitively sought in practice. The average moisture content required for tobacco of the Kentucky type at the time of packing is not less than 15 % which, as a general average, is the percentage of the dry substances contained in the same tobacco when green, and of the dry substances lost during the curing process. In the case of the upper leaves of the plant, as much as 20-22 % of moisture is allowed, for it is only in the blades of these leaves that the amount of dry matter present at the time of gathering and lost during the curing reaches 20-22 %.

VI. — Dr. BERNARDINI has discovered among other facts that : 1) the losses of nicotine are largest in the moistest tobacco and are higher in tobaccos that have been fermented instead of merely cured ; 2) the loss of nicotine through drying in the desiccator is almost wholly confined to the first 10 hours.

VII. — Prof. NOVELLI remarks that the technical institutions and the firms that manufacture desiccators in Italy have made continual improvements in these apparatus of which there are various excellent types, which are in increasing demand in the Italian rice-growing district. He also discusses the advantages of artificial tobacco drying and calls attention to some of the most important problems for the solution of which special experimental work is required.

F. D.

370. The Returns obtainable from a Cinchona Plantation in Java. (1)

I. — BERKHOUT, A. H., De rentabiliteit eener kinaonderneming. *De Indische Mercur*, Year XLV, No. 40, pp. 683-684 Amsterdam, 1922.

II. — VORSTELMANN, J. De rentabiliteit eener kinaonderneming. *Ibidem*, Year XLV, No. 50, pp. 859-860 Amsterdam, 1922.

III. — *Verslag omrent de Gouvernements kinaonderneming de Tjinjvorean (Bandoeng) over 1920*, pp. 1-56. figs 2. Bandoeng.

The Government of Java has obtained very satisfactory returns of late years from its cinchona plantations, the profits realised being as follows in thousands of florins :

1917 — 1004	1920 — 1130
1918 — 249	1921 — 1229
1919 — 910	
(1 florin = 1 s. 53/64 d.)	

The total area under cinchona is 1454 "bouw" (about 1000 hectares) so that the annual profit per "bouw" was about 600 florins. The capital at the end of the year was 800 000 florins.

The Government Authorities connected with the cinchona plantations have always encouraged private enterprise, so that at the present time, there are several plantations belonging to private owners. If cinchona growing had from the beginning been in the hands of private companies it would not, however, have been possible for Java to have obtained the world monopoly of cinchona that she at present possesses, and which is largely due to the fact that the Chamber of Deputies has not the power to liquidate the plantations in bad seasons. As soon as the returns reached 120 000 florins per "bouw", the Government reaped the reward of their perseverance. On account of over-production, 1892-1896 were bad years, the profits obtained being $\frac{1}{100}$ of those secured from 1917-1921. Many private plantations could not survive this crisis. After the War, many tea and coffee planters who were doing badly began to grow cinchona. The market for quinine is limited ; during the War, the demand for this drug greatly increased, but at present, the supply exceeds the demand.

By reducing production, however, the planter could still get high prices. This reduction has been effected, not by retrenching the area under cultivation, but by felling fewer cinchona trees. The remaining trees, as they grow, increase the future supply of quinine, so that in the event of the demand increasing, it can be met from these trees, whereas new plantations do not become profitable for 10 to 20 years. As however, it is probable that the demand for quinine will not increase, care must be taken not to produce within the next few years a crisis similar to that of 1892-96. Measures should therefore be taken at once to avert the danger. In critical times, it is important for the cinchona bark to have a high quinine content. It may be assumed that the gathering drying, packing, transport to Amsterdam and sale expenses of 1 kg. of quinine amount to 10 cents (Dutch). When

(1) See : J. VAN BREDA DE HAAN, *Cinchona Cultivation in Java*, R. Nov. 1915, pp. 1531-1536. (Ed.)

the unit (price per percentage of sulphate of quinine per half kg.), is 2 cents the return of 3 % bark will be $3 \times 2 \times 2 = 12$ cents per kg., and the profit will amount to 2 cents. A 6 % bark gives a surplus of $6 \times 2 \times 2$ cents — 10 cents \times 14 cents, that is to say, 7 times more than a 3 % bark.

If the "unit" is 8 cents the ratio of the net returns from 3 % and 6 % barks is only 1 : 3.

A net return of 2 cents per unit is not enough to cover all the general expenses and wages bill which are over 20 cents per kg. Thus, with a unit of 2 cents, the expenses are only met by a bark with an average 8 % quinine sulphate content.

According to VORSTELMANN (II), no exact comparison can be made between the Government plantations and private plantations, since the owners of the latter have, amongst other things, to consider the question of taxes. VORSTELMANN obtained his data from the reports of private plantations, and found that the expense of sending 1 kg. of bark from Java to Amsterdam was about 59 cents instead of 20 cents. With a unit price of 2 cents and a bark containing 8 % of sulphate of quinine, the expenses would not be covered, and the planter would be obliged to add 27 cents. The author says that the expenses of a good plantation are generally assumed to be covered when the price of the unit is 6 cents. The average sulphate of quinine content of the Javan crop is about 5 %, which gives a return of $2 \times 5 \times 6 = 60$ cents per kg.

BERKHOUT alludes to grafts and states that the offspring of parent trees with a high quinine content are not always equally rich in quinine; further, the development and resistance of the trees must always be taken into account.

The age of the trees is also a very important question in cinchona cultivation, for after a certain age, the quinine content begins to decrease. The following figures come from the 1903 report of the Government plantation. Average quinine content of trees of different ages

1 year, 2.5 % ; 2 years 7 % ; 3 years, 9.5 % ; 4 years, 10.7 % ; 5 years, 10.8 % ; 6 years, 10.4 % ; 7 years 10.3 % ; 8 years, 9.7 % ; 9 years 9.5 % ; 10 years, 9.3 % ; 11 years 9.5 % ; 12 years 9.2 % ; 13 years 9 % ; 14 years 8.4 % ; 15 years 8.3 % ; 16 years 8.2 %.

It may therefore be considered that the percentage increases up to the fifth year, and then remains constant for a time, after which it decreases. The author also quotes data from many similar tables (According to VORSTELMANN (II), it is generally assumed that a decrease in quinine content sets in after the eighth year, but there are exceptions to this rule).

Two systems of working cinchona plantations are employed in Java.

The first consists in cutting down all the trees of a certain lot as soon as they have reached a given age, and replanting the ground the same year. In the second system, only some of the trees are cut down here and there, but young individuals are at once put in their place. It must not, however, be supposed that any trees can be removed as soon as they have attained their maximum quinine content, on the contrary, a system of rotation must be carefully observed :

Example : —

Age	Sulphate of quinine production per " bouw " (76.3 sq ft.)	Age	Sulphate of quinine production per " bouw " (76.3 sq ft.)
years	kg.	years	kg.
3.	16	8	49
4.	24	9	53
5.	32	10	57
6	38	11	61
7	44	12	65
		13	69

Total 508 kg.

Assuming that the plantation has been treated systematically, and that owing to good management, the amount of bark at a certain age is equal to the sum of the products of all the earlier clearings, then with an 8 years rotation on an area of 208 " bouw ", there will be 26 " bouws " of one year old trees, and the same number of " bouws " with two, and three, year-old trees respectively etc., whereas the trees will have been uprooted on 26 " bouws ". The total crops in this case will be $16 + 24 + 32 + 38 + 44 + 49 + 53 + 57 + 61 + 65 + 69 \text{ kg} \times 26 = 10\,556 \text{ kg}$ per annum.

By modifying the rotation, so as to have 13 lots each of 16 " bouws ", bearing trees 1, 2, 3 etc. years old, the trees on 16 " bouws " could be uprooted every 16 years, and 16 " bouws " of trees 3 years old and the same number of " bouws " of trees 4 years old could be thinned. The total annual crop would therefore be $16 \times 508 \text{ kg}$. from thinnings, and the same amount from uprooting, which would mean 16.256 kg viz. over 50 % more than in the first case.

This calculation has been made with the object of proving that a scientific choice of rotation considerably increases the crop without however increasing the up-keep expenses. Probably the best rotation is one of more than 20 years.

Young planters can draw useful conclusions from these figures, but in order for them to be able to compete with their older colleagues, they will need to possess sufficient means to enable them to wait until their plantations attain a considerable age.

In the author's opinion, the second system of managing the plantations is less to be recommended, as its control is far more difficult.

The author's conclusions are that :

- 1) The average quinine content has tended to decrease of recent years
- 2) Bark production increased greatly from 1893 to 1897.
- 3) No increase has been recorded of late years.
- 4) It is the duty of the Experiment Station to study thoroughly the question of the decline, and the means by which it may be remedied.

D. V. S.

371. **The Olive-Tree in French North Africa.**

I. — CORCELLE, A. (Directeur de la Société Industrielle de l'Afrique du Nord). L'Olivier dans l'Afrique du Nord. *Bulletin des Matières Grasses*, No. 5, pp. 127-130. Marseilles, 1922.

II. — REGIS, E. (Fabricant d'huiles) Le Commerce et l'Industrie des Matières Grasses. *Ibidem*, No. 7, pp. 161-173, 1922.

III. — DUBOULOZ. L'Oléiculture in Algérie *Mémoires et Rapports sur les Matières Grasses*, pp. 137-144, Institut Colonial, Marseilles, 1922.

IV — ESTESSE (Chef dy Service de l'Agriculture au Maroc) La Culture des Oléagineux au Maroc. *Ibidem*, pp. 59-74, 1922

V — RUBY J. (Directeur des Services Agricoles des Bouches-du-Rhône) L'Olivier au Maroc *L'Agronomie Coloniale*, Year 8, pp 73-85 Paris, 1922.

VI — TOURNIEROUX (Ingénieur agricole) L'Oléiculture en Tunisie *Bulletin de la Direction Générale de l'Agriculture, du Commerce et de l'Industrie* Year 26, No 109, pp. 19-169, tables, figs 74. Tunis, 1922.

I — The olive-tree is cultivated throughout French North Africa on a zone 80 km. wide, extending along the coast from Syria to South Morocco, but large stands are only found in certain regions and chiefly in the mountainous districts. Olive-growing dates back to remote antiquity, and the wild olive-tree is indigenous to this part of Africa; there are therefore a number of local varieties, which have, however, never been botanically classified.

In all parts of the country there are countless wild olive-trees, in some cases forming regular forests, that only need grafting in order to become a source of wealth. Grafting has already carried out in Kabylia with excellent results, but elsewhere, although the natives are zealous cultivators of the olive, they know nothing about grafting and at the present time, olive-trees are nearly always propagated by the tedious process of cuttings. Attempts have, however, been made to rejuvenate the oliveyards by means of shoots growing out of old trunks cut down level with the ground and by planting large roots of old trees. In these methods, thick branches and fruit have been obtained after three or four years.

The condition of the olive-plantations varies, according to different districts, in some places, old trees bearing little fruit are found, while in others, there are young well irrigated and well-worked olive-yards with a constantly increasing yield.

In many parts, olive-trees are grown in the vineyards where they profit to a certain extent from the care given to the vines, but their fruit under such conditions, although large, has a low oil content and is therefore chiefly suited for preserving.

The olive-trees bear every other year only, on account of the practice of knocking down the olives with a pole. The crop is harvested from November to the end of January. In order to save the expense of keeping the fruit, the Arabs are inclined to gather the olives before they change colour with the result that 4 % of the oil is lost; it is therefore desirable that the Authorities should regulate the time of harvesting.

The natives have the idea that they can obtain the best yield of oil

by piling up the olives in heaps and allowing them to become heated, the results being rancid oils with an oleic acid content of 7 to 8 %. The Arabs however, prefer oils with a strong taste and the practice of keeping the olives in this manner is general, except in Tunisia, Kabylia and Sieg where they are grown for export.

The average industrial yield of North African olives is 16 %, the maximum being 22 % for the olives cultivated on the slopes, and gathered in January, when their skins are already shrivelled, and a minimum of 11 % for vineyard olives. The wild olives are the poorest, and only contain 5 % of oil.

The old, native olive-presses have nearly all disappeared, their place being taken everywhere, except in Morocco, by hydraulic presses which have so largely increased in number, that there are now not enough olives to supply them, hence the competition is very keen and their economic position is highly unsatisfactory.

Olive-oil residues are now everywhere sold at good prices to local extraction factories, they fetch as much on the spot as at Marseilles, though in Morocco they sell at an even higher price for fuel.

It is worth remarking, that except in Argan, North Africa possesses no oleiferous plant except the olive-tree.

ALGERIA. — The author estimates that the Algerian oil production varies around 400 000 quintals, the chief centres being Kabylia, the environs of St. Denis-du-Sieg and the neighbourhood of Tlemcen. It is almost certain that most of the olive-trees cultivated by the natives in Kabylia are old grafted specimens.

II. — The author reckons that the country exported 5600 tons of olive-oil before the war. Since then, the local consumption has increased, and Algeria now uses all its own production of olive-oil, and also imports considerable quantities of pea-nut oil from France.

In Greater Kabylia, large factories have already been started. In addition to the 65 000 hectares under olive-trees in full bearing, there are estimated to be 320 000 hectares of forests, and land covered with brushwood, including wild olive-trees, which could be planted.

III. — The author remarks that care should be taken not to make large olive-yards, for as labour is scarce at the time the crop is ripe, olive-growing must remain a domestic industry. Stock should never be allowed to graze in the olive plantations, since a herd of goats can destroy hundreds of young scions in a few hours, the grafts withering as soon as they are injured. Instead of uprooting wild olive-trees in order to plant Aleppo pines in their place under the pretext of re-afforestation, it would be preferable to graft or replace the wild olive-trees with good varieties.

IV. MOROCCO — The author considers that Morocco will need to develop its olive cultivation considerably in order to keep pace with its own requirements.

The following quantities of olive oil, most of which came from Spain, were imported

688 369	kg. in	1915
1 273 876	" "	1917
175 089	" "	1918
1 189 381	" "	1919

The country is extremely promising for development as regards the olive-oil industry. The number of olive-trees shown in the last census return was 2 167 637. The best olive-growing districts are Fez, Marrakech and Meknès. The above figure does not include the olive-trees in the heart of the Atlas Mts. which have not yet been counted, though they are known to be very numerous.

Before the French occupation, the natives used to fell the olive-trees, but this abuse has been stopped by law, and in order to encourage planting, no tax is levied upon the trees for the first 20 years after plantation. Prizes are also given for planting and grafting, with the result that 36 875 olive-trees were planted, mostly by natives, during the 3 winter months of 1921-22.

The condition of the olive-yards leaves much to be desired, for the trees are too close together (3.50 m.), the fruit is always knocked down with poles, etc. The natives, however, are glad to listen to the members of advisory corps which is being formed by the Agricultural Authority.

At the present time, the annual average yield per tree in the unirrigated regions of the North may be estimated at 12-15 kg. On irrigated land, near Marrakech, the average figure is 20 kg, and the gross production may be as high as 40 kg. For the suppression of theft, regulations are made for the olive-gathering, except in the region of Marrakech. The crop is gathered in November and often proves insufficient to supply the few modern oil-factories started in Morocco which find their whole output absorbed by the local consumption. On the other hand the olive oil residue industry, has every chance of success in the country, as olive-pomace is often used for burning owing to the scarcity of fuel, and fetches 25 to 80 fr. per ton at the mills.

V. — In the first part of his paper, the author describes the different varieties of olive-tree to be found in Morocco. He also gives an account of the present condition of olive-cultivation and of olive-oil manufacture in the country.

The number of olive-trees may be estimated at 2 500 000, and their average annual yield at 20-25 kg. of olives; thus giving for the whole country 500 000 to 600 000 quintals, of which nine-tenths go to the oil-factories. Allowing for the low output of the native mills, the annual production of oil may be reckoned at 60 000 to 70 000 quintals.

OLIVE PLANTATIONS OF THE SOUTH. MARRAKECH DISTRICT. — At Marrakech, there are in the Kénara garden, and the Experiment and Demonstration Field, 7000 magnificent olive-trees growing on deep, regularly irrigated alluvial soil and profiting by the care bestowed on the crops at their feet. They have attained the height of 10-12 ft., but are unfortunately too closely planted, being only 7-8 m. apart.

In the rest of the country, there are 800 000 olive-trees distributed amongst isolated olive-plantations each containing from a few hundred to some tens of thousands of trees. The olive-trees are always irrigated here, the water used for the purpose being either obtained from the subterranean springs by the system of the *rétaras* or else from the *séguia* coming from the *oueds* which are fed by the snows of the Atlas Mountains.

A single variety is mainly grown in all these plantations. Propagation is effected by slips, and there are no traces of grafting. In a hole 0.60 m. in diameter and depth, three cuttings from 0.03 m. to 0.05 m. in diameter, and 0.50 m. to 0.60 m. in length are planted, and covered with earth to within 0.03 m. or 0.04 m. of the top. The cuttings are planted out either from November-December, or else from March-April. They are watered from the time with due regard to the need and amount of the water at disposal. The trees begin to bear about their fifth year. They do not suffer in any way from the presence of cover-crops, such as cereals, beans and winter forage, as these are well tended. The only diseases that have been reported are the olive-tree canker (*Bacillus oleae*) and the olive-fly (*Dacus oleae*) though both are very rare. In the best years, the trees, produce 80 to 120 kg. of olives, but in bad seasons, the crop is almost negligible; it may be estimated at 30-50 kg. in the case of regularly irrigated trees.

OLIVE PLANTATIONS OF THE NORTH DISTRICT OF MEKNÈS AND FEZ. -- The trees are planted at intervals of 5 to 10 m. Few new plantations are made, and in every case they are planted with single cuttings which are after 12 to 15 years, in order to give space to the young olive-trees.,

After the crop is gathered, the natives very frequently scrape the soil. Semi-circular basins, often containing dung or olive-residues, are made at the foot of each tree to catch the irrigation water. Pruning is no longer practised, and even the shoots of the trunk which are browsed upon by live-stock are not cut off. Excellent results can be obtained by irrigation, but even unirrigated plantations, those of Zerhoun for instance, do not show the signs of degeneration, which are observed in the south.

In the region of Meknès, all the parasites of the olive-tree known in Europe are to be found, scale insects, *Dacus oleae*, and the mining caterpillar (*Prays oleae*). Fumagine is regarded as the most formidable disease.

The yields are lower in Meknès than in the district of Marrakech on account of the smaller size of the trees, the frequent want of irrigation, and parasitic infestation. The average annual yield per tree may be estimated at 10-20 kg. of olives.

VI. TUNISIA — The author has written a very complete study of olive-growing in Tunisia, in which the following questions are considered: Olive cultivation in Tunisia during the Roman period and at the present day, the olive-oils of Tunisia, the cultivation of the olive-tree (soils, propagation, plantation making, cultural operations, pruning, irrigation, manuring, fructification, harvesting, sale price of olives, yield and cost varieties, cover-crops, methods of planting, organisation of an estate, stands of wild olive-trees, preserved olives); the enemies and diseases and other risks of the olive-tree; Tunisian laws for the regulation of the olive-growing industry.

The industry was very prosperous under Roman rule, and since 1881, it has again been greatly developed, 4 000 000 olive-trees having been planted since this date on 14 500 hectares. The total number of trees thus obtained is 12 563 000 of which 10 155 000 are in bearing.

The Northern district has 3 600 000 trees, but they are mostly old specimens growing in irregular plantations, many of which are pulled up for use as fuel. On good soil, the olive-tree is obliged to yield precedence to cereal crops.

Vast works have been carried out in Sahel in order to reclaim and provide water for the dry hillsides. This district already possesses 4 000 000 olive-trees, and the native are so much interested that it is certain that all the land suitable for the purpose will soon be planted with olives.

In the Sfax district, the soil is deep and siliceous and well suited to olive-trees. The number of trees was 380 000 in 1810, but has now risen to over 3 000 000 owing to the enterprise of French planters. Nearly 2 000 000 trees will, however, not reach their maximum yield before 1930-1940. Excellent plantations are to be seen composed of trees set in squares with wide spacing (20-24) and in straight lines, each individual being well pruned and maintained. All the old plantations have been gradually cut down as the trees died. The natives are so anxious to make new plantations, that the authorities are obliged to restrain their ardour, in order that there may not be too sudden a change in the equilibrium between the land under olives and the area devoted to the cultivation of cereals and the grazing of the travelling flocks of sheep.

In the CENTRE, the soils are either siliceous similar to those of Sfax, and therefore very suited to olive-trees, or else they are very dry and require irrigation. Olive cultivation was a very prosperous industry under Roman rule, but was afterwards abandoned in this district, good crops have, however, been obtained lately from some young plantations, although their development will certainly be delayed owing to the cost of well-construction and the character of the inhabitants, who are incapable of any sustained effort.

THE SOUTH. — The soil in the extreme South also resembles that of Sfax, but owing to the hot, dry climate, it needs irrigation. The possibilities of the country are well seen in the forest of Djerba with its 900 000 old, unirrigated trees, and in the flourishing young plantations of 200 000 trees at Zarzis and Ben Gardane. There is no doubt that with adequate means of irrigation, the natives could succeed in growing olives wherever Roman civilisation has left its traces in the district.

The amount of olive-oil exported by Tunisia before the War, was in the neighbourhood of 100 000 quintals. In 1917 and 1919, it rose to 235 000 and 219 000 quintals respectively, as the young plantations especially those of Sfax, had by that time come into bearing and furnished an appreciable supply of olives.

The oils of the North are fruity and highly-coloured. Those of Sahel are somewhat inferior in both these respects resembling more nearly the oils of Bari to which place, they are actually exported.

The Sfax oils are slightly fruity and are much liked by the general public in France. Unfortunately, they coagulate even more readily than those above mentioned.

Tunisia possess numerous modern oil-factories, and 7 factories for the treatment of the olive-oil residues.

No over-production need however be feared in the near future, for olive-cultivation is in fact stationary or retrograde, in the districts where it is most developed. Olive-oil is also in increasing demand and much preferred to seed-oil. Since olive-trees only do well in Tunisia on poor soils and considerably increase their value, for instance in the Sfax region, land used for grazing travelling flocks was worth 40 fr. per hectare in 1914 and at the same date, similar land under olive-trees in bearing was valued at 850 to 1700 fr. per hectare, it may be said that the economic conditions of olive-growing in the country are eminently satisfactory (1).
R. D.

Crops.

372. The Distribution of Varieties of Wheat in France.

BRETIGNIÈRE, L. *Revue de Botanique appliquée et d'Agriculture coloniale*. Bulletin No. 16, pp. 785-792, 2 maps. Paris, 1922.

The differences in the climate in the various parts of France long ago necessitated types of wheat suited to local conditions. These "*blés de pays*" still occupy 1 800 000 hectares of the land under cereals and include *Blanc de Flandre*, *Barbu de Champagne* and the Alsatian varieties (Seille and Altkirch). In the S-S.E., types of wheat with tapering ears are met with. The South-Eastern varieties (*Saizettes*, *Tuzelles*) are drought resistant. *Blé de Roussillon*, which is grown on poor land exposed to scald, is replaced by *Bladettes* and *Blancs* in the basin of the Garonne, wherever the conditions are more favourable. In the poor regions of the Massif Central, a wheat similar to Roussillon is cultivated. Throughout nearly the whole of Brittany and Normandy and in the Paris basin, the improved wheats have been substituted for *Franco Blés à barbes* (awned) and *Chicots sans barbes* (awnless).

Since 1830 Spanish, Italian and Russian wheats have been increasingly cultivated on the plains of South and Central France, but their extension is checked by the cold, although *Blé bleu*, or *Blé de Noé* can thrive as far as Beauce, and one variety, *Gros bleu*, is still grown largely in the Centre. In the middle of the XIX century English wheats gained a footing on account of their dense ears and stiff straw, and were grown in the North and North-West of France. Now, however, their sole representative is *Goldendrop*, a variety that is only suited to poor soils and cold climates, and *Wilhelmina*, a wheat suitable for cool, fertile soils of districts with a maritime climate.

At the end of last century, Henry de VILMORIN obtained many new types by crossing. *Bon Fermier* and *Hâtif Inversable* are well-known in all parts of the country where the soil is rich, and cover 1 200 000 hectares. *Dattel* has maintained its position in the North, as has *Trésor* where the

(1) As regards the Italian Colonies see: *Passé et Avenir de la culture de l'olivier en Lybie*. Bulletin de la Direction Générale de l'Agriculture, du Commerce et de l'Industrie. Tunis, May 1917, pp. 68-70. (Ed.)

FIG. 81.

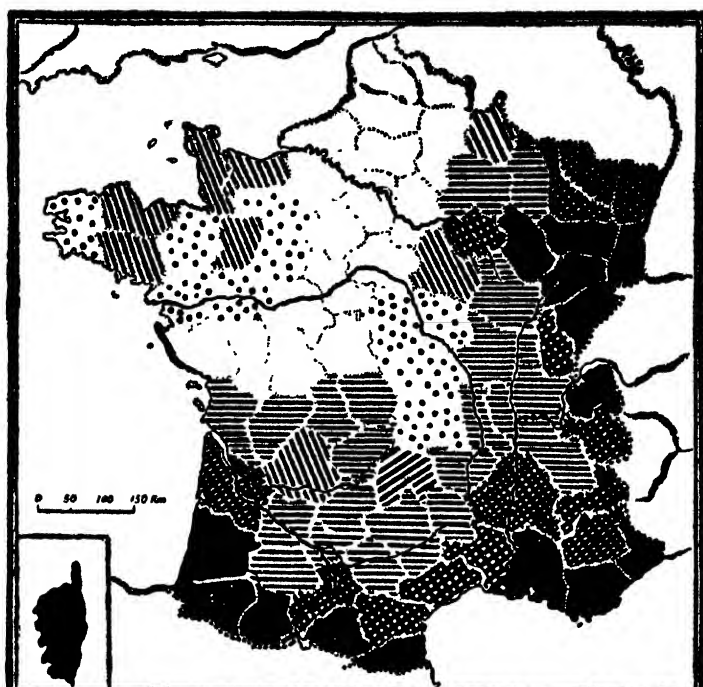


FIG. 82.

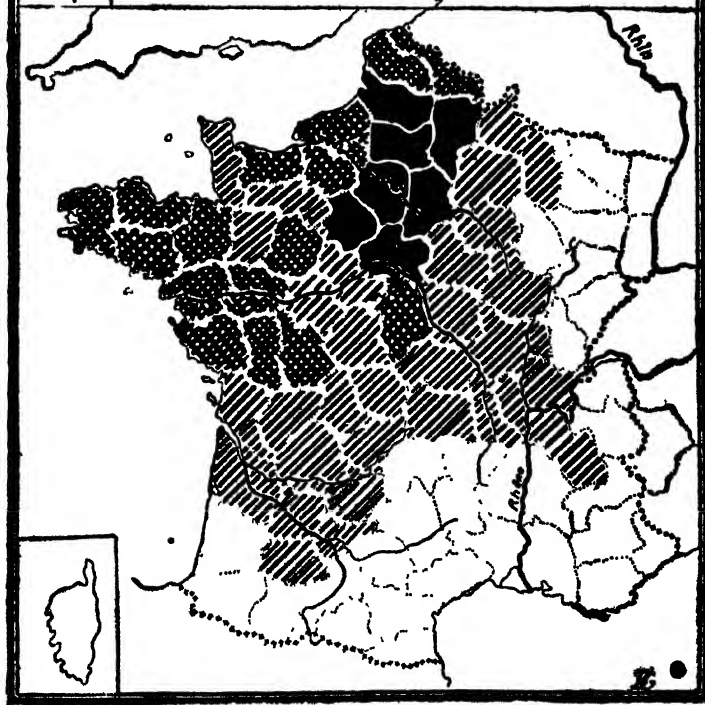


FIG. 81. — *Distribution of the varieties of wheat in % of area under wheat in France*: White: below 10 %; Dotted: 10 to 25 %; Diagonally shaded: 25 to 50 %; Horizontally shaded: 50 to 75 %; Cross-hatched: 75 to 90 %; Black: above 90 %.

FIG. 82. — *Distribution of the varieties, Bon Fermier and Hâlis, Inversable in % of area under wheat*: White: below 10 %; Shaded: 10 to 25 %; Cross hatched: 25 to 50 %; Black: above 50 %.

land is fairly fertile. *Japhet*, grown in the polders of Mont St. Michel is, on account of its high yield a favourite in the West, Centre and South-East of France, while in the North, it is cultivated as a February wheat. Finally in 1917, 1920 and 1922, VILMORIN created other varieties *Alliés Paix* and *Vilmorin 22* which will doubtless be largely grown.

The cereal-breeders of France have tried to obtain by means of crossing, varieties of wheat adapted to the different regions.

DENAIFFE, in the East, has created cold-resistant types, while BENOIST has produced, at Beauce, varieties suitable for rich soils. The Alsatian wheats have also been improved, and in this way, *Colmar* and the Jurassic varieties have been obtained. However the general use of these wheats is not to be recommended, as it is preferable to start again from local types. Thus, near Valence, the *Saisettes* are being studied, whereas elsewhere, different varieties of Italian wheats (*Carlotta Strampelli* and *Rieti*) are the objects of research. In the South-West, where resistance to scald and wind are the chief characters sought, *Beplas* is taken as a starting point.

Some March wheats grown in the North (*Chiddam*, *Saumur Manitoba*, *Marquis* and *Aurore*) do well in the South-East, if sown very late in the autumn.

From an enquiry made in 1912, the *Blés de Pays* were found to be in complete regression, therefore if the climatic variations in France do not allow of the general use there of wheats with dense ears and very high yield, it is necessary to propagate improved, early-maturing varieties adapted to the conditions found in that country (See Fig 81 and 82)

R. D

373. Experiments with Varieties of Rice introduced into Spain.

GONZALEZ, J Ensayos de germinación des arroces *Estación central de Ensayo de Semillas La Moncloa. Madrid, Boletín trimestral* Year II, No 7, p. 11. Madrid, 1922

The "Estación Arrocera del Delta del Ebro" (Tortosa) has directed the Seed Testing Station at Moncloa (Madrid) to make germination tests with 37 varieties of rice collected from the 1922 crop. The results should permit a selection to be made of varieties suitable for the existing climatic conditions.

With the exception of two varieties giving negative results ("skiro wasque" and "lencino", which showed a germination capacity of only 11.6 and 18 % respectively) and of three medium varieties (60 to 65.3 % germination), all the rest gave satisfactory results. Above 90 % germinating capacity are included: "amonquili" 90.3, — "ostiglia" 90.6 — "kitakawa" 91.0 — "joi ruski" 93.0 — "bulverano" 93.6 — "onsen" 93.6 — "sekaioi" 94.3 — "originario 3" 95.6 — "takatzu" 95.6 — "bomba" 96.0.

F. D.

374. The Lesser Cereals.

CHEVALIER A, Les petites céréales. *Revue de Botanique appliquée et d'Agriculture Coloniale*, Vol. II, No. 14, pp. 544-550. Paris 1922.

The author applies the term "small cereals" to certain gramineae which either in their wild, or cultivated condition have afforded sustenance to man, although they are of less importance than the cereals usually grown for food. The yield of these gramineae is low, but they thrive on poor land requiring little preparation and will grow on a very thin layer of vegetable mould and on soils where no other cultivated crops can exist. As these unexact plants require the minimum of attention, they were cultivated in very ancient times, probably long before the cereals properly so-called. In the most remote ages man used the seeds of these wild gramineae as a food. In times of famine the fruits of the bamboo are eaten in British India, while in Central Africa, the author has seen tribes, such as the Bagnirmi, the Kotoko, etc eat large quantities of the fruits of small, wild cereals.

In the centre, as well as on the borders, of the Sahara, the seeds of *Panicum turgidum* Fotsk. are eaten in seasons of dearth, the grain being obtained from deposits made in the sand by ants.

In the basin of the Tchad, the various gramineae used for food are known among the Bagnirmi under the name of Krebs. The chief species thus employed are: *Panicum Kotschyanum* Hochst., *Eleusine indica* Gaertn., *Dactyloctenium aegyptiacum* Willd, and some species of *Digitaria* and of *Seturia*. Possibly they were all once cultivated, but now they rank among the protected semi-cultivated plants.

In tropical Asia, *Panicum crus-galli* L. and *Panicum colonum* L. are used for food; while in Europe, the grain of *Digitaria sanguinalis* Willd. is gathered and made into bread, especially in Poland. *Digit. sang.* may perhaps have been one of the lesser gramineae earliest cultivated during the Neolithic Age. F. HOOKER states that it is still grown in Khasia (British India).

In South America, the Indians of Peru collect the seeds of *Milium paradox* Nutt. which they crush and make into flour and beer

The following 12 principal species of lesser cereals are known:

I. — *Panicillaria spicata* Willd., *Holchis spicatus* L., *Pennisetum Syphoidem* Lank. and the "petit mil," or "mil chandelle" of the French African colonies which is known in British India as "Lanion", "Bambaras," "Bubrush," "Bajra," or Bairj. This plant is believed to be a native of tropical Africa, but is no longer found wild there. It is, however, extensively cultivated throughout the Sudan, in Sahel, North Africa, Egypt, Madagascar, Angola, and South Africa, while in British India, it is one of the most widely-grown cereals.

II. — *Setaria italica* (L.) Pall. — *Panicum italicum* L.-*P. glomeratum* Moench. — *P. germanicum* Willd. — *Pennisetum italicum* R. Br. — *Setaria germanica* P. Beauw. The latter is considered by some botanists to be a cultural form of *S. viridis* Pall; it is the "miglio," or "milio degli uccelli" of Italy, and in France, it is called "panouil", "moha,"

"millet de Hongrie"; in British India it passes by the names of "Kangai", "Kanku", "Chena" etc. This millet is said to have been indigenous in China and Japan whence its cultivation has extended westward, for it is now grown in France (the Mediterranean region and the Pyrenees), in Germany and Bohemia, as well as in Italy, where several varieties distinguished by the colour of their seeds are known (*S. violacea* Horn., *S. flavida* Horn., *S. erythrosperma* Horn.). It is also widely cultivated in British India, Persia, China, Japan, the Philippines, Malaysia, and by the inhabitants of the Mountains of Indo-China. This species of millet was introduced a long time ago into America and also into South Africa, where it is called "Boer Manna".

III. — *Phalaris canariensis* L. = *Ph. ovata* Monob., this plant is not to be confused with *Ph. sativa* Pers. which belongs to the genus *Phleum*. *Ph. canariensis* is also known as Canary-seed, and "scagliola"; the French call it "Alpiste" "Millet long", "Escayol", "Mil des Canaries". It is supposed to be a native of the Canary Isles and of the Iberian Peninsula, and is possibly derived from *Ph. brachystachys* which grows wild in the Mediterranean region. *Ph. canariensis* is cultivated here and there in France and in Corsica, Italy, Spain, North Africa, the Canary Isles and North-west India Morocco is however, the country where it is chiefly grown.

IV. — *Panicum miliaceum* L. = *Milium esculentum* Moench. = *M. Panicum* Mill. This is the common millet called by the French, "Mil en branches", "Mille", "Millet rond", "Mil de l'Inde", "Graine de Canarie". In British India, it goes by the name of "Chena Chin Sphikai". Two varieties are distinguished "phikai" and "rali". It is supposed that this cereal came originally from Egypt, or Arabia; THELLUNG thinks it is also a native of Central Asia. *Pan. miliaceum* is grown in South France and North Africa and is extensively cultivated in temperate and tropical Asia (British India and China), and is raised on a small scale by the mountain-dwellers of Indo-China.

V. — *Panicum miliare* Lank. Small millet, known in British India as: "Sava", "Kung", "Kutki," and "Chika". It greatly resembles the preceding species, but has smaller seeds. Some botanists regard it as the cultivated form of *P. psilopodium* Trim., a wild millet found in India, Burma and the Malay Peninsula. This species is cultivated only in British India and Ceylon, and perhaps also in Central China.

VI. — *Panicum frumentaceum* Roseb. (not Salisb.). This species is often regarded as a variety of *P. Crus-galli* L. Its synonyms are: *P. grossum* L. — *P. segetale* Herb. Roxb. — *Echinochloa frumentacea* Link — *Oplismenus frumentaceus* Kuntk.

In British India, where it is widely cultivated, this cereal goes by the names of "Shama", "Shamalu", "Mandira", or "Banti." It is also grown in China. ROXBURGH believes this form to be derived from *P. hispidulum* Roxb. which is merely a variety of *P. Crus-galli*. Most authors consider that *P. frumentaceum* possesses character intermediate between those of *P. Crus-galli* L. and *P. Colinum* L. The latter is a ubiquitous

species cultivated in the Punjab, according to WAIT, for its seed and known by the names of "Savank", or "Wundu".

VII. — *Panicum esculentum* ». R. Br. possibly a variety of the preceding; it is cultivated in Japan.

VIII. — *Paspalum scrobiculatum* L. = *P. Commersonii* Lank = *P. frumentaceum* Rothb = *P. hirsutum* Retz = *P. Kora* Wild.

This cereal grows wild in all hot regions and is cultivated in British India where it bears the names of "Kodra", "Kodo" and "Kodam", and covers many million acres. According to WATT, the seeds of some of its varieties contain a toxic principle.

Pan. scrobiculatum is much used as a forage plant.

IX. — *Digitaria exilis* (Kipp.) Stapf. = *Paspalum exile* Kippist = *Pasp. longiflorum* Franchs, Chev. (not Retz). A species very nearly related to *Dig. longiflora* Pers.

This plant is extensively cultivated by the natives of West Africa (French Guinea, Sierra Leone, French Sudan, Upper Volta, and North Nigeria). It is the smallest cereal known, since its height never exceeds 10 cm., and its seeds are minute. It will grow on any soil, provided the annual rainfall is not less than 80 cm. There are many varieties of *Digitaria exilis* and in the territories of Fouta Djallon and of the Upper Niger, this cereal is the chief crop and the staple food of the natives.

X — *Eragrostis abyssinica* Link = *Poa abyssinica* Jacq. = *Panicum Teff* Dey. A plant known to the natives of Abyssinia under the name of Teff and derived from *E. pilosa* (L.) Pall. This cereal is much grown in the mountainous districts of Abyssinia and especially in the neighbourhood of Galla. It has also been reported from Upper Egypt and Nubia. It was introduced into South Africa as a forage plant and in Rhodesia produces about 2 tons of forage per acre. *Erag. abyssinica* is cultivated in Europe as an ornamental plant and has become semi-wild.

XI. — *Eleusine Coracana* Gaertn. = *E. cerealis* Salisb. This plant, which the colonists call "Coracan", or "Eleusine", is known in India as "Ragi", or "Makra". It is the cereal most extensively cultivated in India where it annually covers an area of 7 million acres and yields about 400 lb. per acre.

Eleusine Coracana is believed to be derived from *E. indica* a wide-ranging species found wild, or acclimatised, in all the tropical and temperate regions of the world. Two sub-species are to be distinguished: *E. stricta* Roxb. cultivated in India, and *E. Toccusso* Fres. grown in Abyssinia. *Eleusine Coracana* is cultivated not only in India, but, also in Ceylon, Madagascar, a large part of the Belgian Congo, in Ubangi and Chari. The flour made from it is used as a food, and also in the manufacture of beer. In East Africa, this cereal is grown from Upper Egypt to Mozambique; it has also been introduced into America.

XII. — *Coix Lacryma-Jobi* L., var. *Ma-Yuen* Stapf. *Coix Lacryma-Jobi* has been acclimatised in all parts of the globe, but only one (Ma-Yuen) out of its many varieties is cultivated as a cereal. This is grown in Sikkim, Khasia, India, Burma, China, the Philippines and Indo-China. In Japan it is said to be cultivated for making beer, while

in the Philippines, where it goes by the name of "Adlay", it furnishes according to P. J. WEBSTER (*Philip. Agric. Review*, 1921, p. 159) a nutritious and agreeable food having a higher nutritive value than wheat. It is used mixed with $\frac{1}{3}$ or $\frac{1}{2}$ of wheat flour. WEBSTER is of opinion that if the cost of producing "Ma-Yuen" could be reduced and the quality of its grain improved, it might be cultivated, at all events in the Philippines, in the place of rice; it would grow well in North Africa and throughout the Mediterranean region. F. C.

375. Nutritive value of Dawa-dawa Pods from *Parkia* sp. on the Gold Coast.

Bulletin of the Imperial Institute. Vol. XX, No. 4, pp 461-463. London, 1922.

The seeds of the dawa-dawa (*Parkia filicoidea*?), the leguminous tree common throughout the northern territories of the Gold Coast are used by the natives as a food. On analyses of pods at the Imperial Institute, London, it was found that both the powdery material in which the seeds are embedded, and also the seeds, though different in character are both of satisfactory composition as foodstuff. The powdery material is of value owing to its richness in carbohydrates, (sugars 27.7 % — 35.8 %) and the seeds on account of the high percentage of proteins 28.5 % and fat, 16.8 %. Neither contained alkaloids nor cyanogenetic glucosides.

The pods consisted of pod-case 41.2 %; powdery material 33.4 %; seeds 25.4 %. It is stated that on the Gold Coast, the aqueous extract from the pod-cases is used for binding floors. The material is of a pectic nature having adhesive properties; a quantity of tannin is also present.

M. L. Y.

376. Pasture Top-Dressing Experiments at Te Kuiti.

PATTERSON, T. H., *New Zealand Journal of Agriculture*, Vol. XXVI, No. 4, pp. 233-238, tables 2, figs. 5. Wellington, 1923.

The author gives an account of phosphatic fertiliser trials carried out on permanent pasture. The experiments were carried out on pasture laid down 8 years previously and which had received no fertilisers for more than 5 years. The average results of two years' trials is given below:—

Fertiliser used	Amount per acre	Yield of Hay per acre av. of 3 plots				Increase due to Fertiliser				Percentage increase
		tons	cwt.	qr.	lb.	tons	cwt.	qr.	lb.	
<i>Unlimed</i>										
Check.	None	1	3	0	1	—	—	—	—	
Basic slag.	3 cwt.	1	12	2	2	0	9	2	1	41.3
Superphosphate . . .	3 cwt.	2	3	0	6	1	0	0	5	87.1
Rock phosphate . . .	3 cwt.	1	11	1	22	0	8	1	21	36.7
<i>Limed</i>										
Superphosphate . . .	3 cwt.	2	0	0	17	0	17	0	16	74.5
Rock phosphate . . .	3 cwt.	1	7	2	16	0	4	2	15	20.1

The figures show that under the conditions of the experiment, superphosphate gave a much higher yield than slag or rock phosphate. Differences in the nature of the herbage on the plots were noted, Yorkshire fog being abundant on the superphosphate plots; the feeding quality of the pasture as a whole was improved.

The average rainfall during the two years' trials was 56.80 and 53.85 inches respectively.

W. S. G.

377. Forage Plants for Dairy Cattle in New South Wales.

HAYWOOD, A. H. (Manager, Wollongbar Experiment Farm) Dairying under North Coast Conditions *The Agricultural Gazette of New South Wales*. Vol. XXXIV, Part I, pp 41-48. Sydney, 1923

The information given in this article is based upon experiments made at the Agricultural Station at Wollongbar. The author recommends the following forage plants for dairy cattle, cultivated under conditions of drought such as are met with on the northern coast of New South Wales.

Paspalum repens grows luxuriantly in summer, but towards the end of that season, it seeds and quickly loses its nutritive properties. Further, after some years the ground on which this crop has been grown becomes covered with roots that prevent the air having access to the soil and cause the loss of much rain-water.

In order to remedy this difficulty, the author recommends that the crop be ploughed-in, so that it may rapidly decompose, after which a strong-growing plant that will exterminate *P. repens* must be sown. *Sorghum halepense* is very suitable for the purpose. After a second crop has been grown, the ground may be again sown with *P. repens*.

In addition to *S. halepense* which is very well adapted for the first crop, there are other plants that can be used such as Elephant Grass (*Typha elephantina*), Guinea Grass (*Panicum maximum*), "piassava", (*Attalea funifera*) and "Kikuyu Grass" (*Pennisetum clandestinum*) all of which are equally suitable. They make a good change of fodder for stock which eat them with avidity.

The pastures should be divided into enclosures so that green food can be provided for the animals at almost every season of the year. This subdivision of the ground would also encourage the growth of white clover (*Trifolium repens*) which is apparently the only plant able to live in company with *Paspalum*. When several small enclosures are available, the cattle can be turned into one to keep down the *Paspalum*, which may be cut in another by means of a reaper and removed, thus giving the white clover a better chance to grow. *Paspalum repens* can be made into silage, but it has little nutritive value and must be fed with concentrates. It makes an excellent litter. Among the various grasses that can be used the author recommends *Dactylis glomerata* (Cock's foot grass), *Bromus ciliatus*, and *Agropyrum repens* (Couch grass). These grasses supply a large amount of nutritious appetising food during the 2 or 3 years before *Pas-*

palum repens has taken possession of the ground ; they also make excellent winter fodder.

Rhodes Grass (*Chloris Gayana*) is another very useful plant, but it must be prevented from growing too rank, otherwise it becomes tough and unpalatable to the cattle. This applies also to Guinea Grass (*Panicum maximum*) which makes excellent fodder and yields sometimes as much as 40 tons per acre. The native blue couch grass (*Agropyrum*) has always been valued as a stock feed and also on account of its resistance to long periods of drought. Para Grass (*Panicum molle*) makes good hay, and stands trampling and frequent grazing. Other grasses also mentioned by the author, in this connection are: " Kikuyu Grass " (*Pennisetum clandestinum*) which must be kept closely grazed, and Elephant Grass (*Typha elephantina*).

For a farm of 100 acres, the author suggests the following fodder plants being sown on an area of 20 acres :

Maize	5 acres
<i>Sorghum halepense</i>	5 "
Cow cane (<i>Saccharum officinarum</i>)	5 "
Wheat	3 "
Sweet potatoes	2 "

Total 20 acres

Fitzroy is the best variety of maize for fodder in New South Wales. One of the advantages of maize is that it can be grown as a mixed crop with pumpkins, Italian rye-grass or *Vigna sinensis*.

Sorghum halepense, if sown in August or September, is ready for cutting in February, but it is chiefly valuable as a winter fodder. If sown in February, it will produce 15 to 20 tons per acre and provide fodder throughout the winter and as late as the end of August. This variety of *Sorghum* should not be grazed on the field, but cut and fed to the stock, mixed with a concentrate such as ground maize or oats, and bran. Thirty lb. of chopped sorghum mixed with 4-5 lb. of concentrates make a good winter ration.

The cereals, wheat and oats, may be cut as green fodder in winter, or hay in the spring, and chopped and fed with concentrates. If they are likely to be attacked by smut or rust, they must be cut early and used for chopped straw. The varieties of wheat preferred by farmers are : Thew, Warsen and Huguenot.

Algerienne is the favourite kind of oats. The author advises that more wheat and oats be grown, mixed with vetches or field-peas.

The common sugarcane and the Indian variety also make excellent fodder when mixed with a concentrate. The Indian variety of sugarcane should not be grown where the ordinary kind thrives satisfactorily.

F. S.

378. **Behaviour of Hubam Clover in Ohio. (1)**

WILLARD C. J. (Ohio State University). *The Breeders Gazette*, Volume LXXXIII, No. 15, pp. 505-506. Chicago, April 1923.

Results of two years observations, made in Hubam clover compared with sweet white biennial clover are summarised as follows :

Hubam in favourable seasons will give a larger yield of hay, following cereals, than any other clover. The yield was 3930 lb. per acre following early oats, compared with 2570 lb. of the biennial. As regards total growth, the biennial has proved superior : 240 lb. roots, and 2730 lb. tops (Hubam) and 1480 lb roots and 2090 lb. tops (biennial). As a soil improving crop, Hubam is therefore not recommended except where an annual crop is required. The nitrogen content of both roots and tops also compared unfavourably with the biennial. The weed problem is also a difficulty, but the value of Hubam clover in many situations where more expensive seed is impracticable, should not be overlooked. The value as a honey producer and the fact that it is possible to have a continuous production of bloom from late in May until after frost, by relying on biennial sweet clovers, and on Hubam is worth consideration.

Superior root yields have been reported in Iowa and indicate that under certain conditions, Hubam roots are equal in value to biennials.
M. L. Y.

379. **Sunflower Silage.**

AMOS, A. and WOODMAN, H E (School of Agriculture, Cambridge University). *The Journal of Agricultural Research*, Vol XIII, Part 2, pp. 163-168. London, April, 1923

An account of trials with the « Giant Ensilage », sunflower variety, grown for storage in the silo. This crop, planted on light gravel soil gave a yield of 20 tons of green matter per acre, containing 18.5 % dry matter, which compared favourably with the maize crop grown simultaneously (14 tons per acre).

After storage in the silo for three months the silage was examined and appeared to be of good quality, after removal of the top layer of waste material. An outstanding feature of the results was the extremely low percentage loss of dry matter which occurred, namely 4.8 %, appreciably lower than any of the corresponding figures obtained in the ensilage trials with oats and tares. The crude protein underwent very little change, but the digestibility value was somewhat lowered. Full data is given with reference to the composition and changes in content of dry matter of green sunflower and sunflower silage.

Trials made in the United States have already demonstrated the value as a stock feed and as a substitute for maize silage. An experiment to test the palatability of this fodder was made at Cambridge. The authors consider, however, that further investigations as to digestibility and value as a cattle feed, and improved methods of cultivation in order to reduce the fibrous nature of the stems, are necessary before sunflower silage can be recommended on a large scale for feeding stock.
M. L. Y

(1) For experiments in Natal (S. Africa) with Hubam, see R. 1922, No. 415. (Ed)

380. Experiments in the Close Sowing of Linseed.

OPTZ, Versuche über die Aussaatstärke von Lein. *Illustrierte landwirtschaftliche Zeitung*, Year 43, No. 12, pp 93-94. Berlin, 1923.

On account of the high price of linseed, German research workers have endeavoured to determine whether it might not be advantageous to use thinner sowings than those generally customary, with the object of increasing the seed crop yield. The author gives an account of the results of experiments made at the Silesian Chamber of Agriculture and carried out under his direction. In the first trials 152 — 112 — 80 — 53 kg. of seed were used per hectare, yielding respectively 670 — 655 — 619 — 529 kg. of seed per hectare; 3800 — 3390 — 2910 — 2220 kg. of straw and husk, 872 — 656 — 579 — 391 kg. of tow and fibre and 596 — 423 — 362 — 236 kg. of fibre.

In the second trial, 240 — 160 — 120 — 80 — 40 kg. of seed were used per hectare, giving yields of 498 — 504 — 571 — 598 — 574 kg. of seed per hectare, 3950 — 3360 — 3240 — 2975 — 2275 kg. of straw; and 810 — 676 — 574 — 417 kg. of fibre per hectare.

Thus in both the trials the straw yield, as was to be expected, diminished as the seeds were more sparsely sown, while the seed yield showed some diminution in the first case when the seeds were sown in rows and an increase in the second when they were broad-casted.

Speaking generally, it is desirable to use medium close sowings, the price of the seeds and fibre determining whether the sowing should be reduced or otherwise.

F D.

381. East African Bamboo as a Paper-Making Material.

Bulletin of the Imperial Institute, Vol XX, No. 4, pp 458-460 London, 1922

Extensive forests of bamboo (*Arundinacea alpina*) are found in Kenya Colony, the value of which for paper-making has been definitely ascertained by investigations carried out at the Imperial Institute. Licences are issued by the local Government for working two Forest areas, one of which is situated on the slopes of the Kikuyu Escarpment and the other in the Mau Forest Reserves. These areas are capable of yielding about 60 000 tons of paper-pulp annually. The system of cutting will be based on a ten years' rotation, that is to say, each block which has been cleared will be given ten years rest before it is cut again.

In 1920, trials were carried out in the laboratory of the Imperial Institute and by a Firm of paper manufacturers. The bamboo stems were from 1 5 to 2 inches in diameter, with nodes from 18 to 24 inches apart. Chemical analyses were made for comparison with the Indian bamboo (*Bambusa Tulda*) the results of which were as follows:

	East African bamboo per cent.	Bambusa Tulda per cent.
Moisture	9 5	8 6
Matter soluble in water	3 6	2.5
Cellulose in material as received	47.5	53.4
Cellulose expressed on moisture free material	52.5	58 4
Ash	1.2	4 1

The length of the ultimate fibres was from 1.6 to 2.7 mm., with an average of 2.3 mm., being almost identical with the measurements of *Bambusa Tulda*.

The pulps obtained in the trial had good felting qualities and formed a pale brown paper of good strength. The pulp was readily bleached and yielded a white paper of good quality: the amount of bleaching powder used was about the same as in the case of soda wood-pulps. The yield of pulp was slightly lower than that from the Indian *Bambusa Tulda*.

A firm of paper manufacturer's carried out trials with about 1 ½ tons of the bamboo and obtained a pulp which bleached satisfactorily and yielded a good quality paper. The pulp when converted into a pale-tinted paper yielded 41.23 per cent. (including loading and size) of the weight of the bamboo treated. The bamboo is considered to be a promising material, but improvement would result by keeping stems of different ages separate from one another. This source of pulp for the manufacture of paper is well worth further consideration. W. S. G.

382. Observations concerning Tannin in the Tea Leaf.

CARPENTER, P. H. and HARLER, C. R., Scientific Department, Indian Tea Association, *Quarterly Journal*, Part III, pp. 99-107, tables 4, figs. 3, bibliography. Calcutta, 1922.

North-East Indian teas are generally pungent, with "body" and the price of Assam tea is based largely on the tannin content, with which its qualities are connected more or less closely. Finished Indian teas contain more tannin than those from Ceylon and China, as shown by analysis.

	Tannin % on dry finished black teas		
	Variation	Average	
Indian Teas	13.32 to	14.98	14.33
Ceylon "	10.31 "	13.91	12.29
China "	7.27 "	10.94	9.50

The fresh shoot contains from 25 to 30% tannin which, during the subsequent fermentation is reduced to about 15 %. An interesting point is that China bushes grown in Assam have practically the same tannin content as Assam bushes.

In the authors' experiments the tannin was estimated by Lowenthal's method, which consists in determining the oxidisable matter in solution by means of permanganate of potash, both before and after precipitation by gelatine. The difference is a measure of the tannin bodies and a factor is used for conversion of the difference into weight of tannin. For the experiments two half-acre plots were used, one of dark leaved Burma bushes, the other of light leaved, Singlo, Assam native bushes. Two types of pruning were employed, annual and biennial on each plot. The shoots when plucked were divided into bud, first leaf, second leaf and stalk, and each portion was boiled for half an hour in water and the filtered liquid was then analysed for tannin.

*Tannin content of Tea shoots, average percentage on pluckings
from May 26th to November 17th.*

	Bud —	No. 1 Leaf —	No. 2 Leaf —	Stalk —
Burma Tea pruned to 14 in. plucked at 27 in.	25.49 %	26.37 %	21.63 %	12.87 %
Burma Tea pruned to 10 in. plucked at 27 in.	24.67	26.28	21.09	11.62

From the above data it is seen that the lighter pruned bushes produce more tannin than the lower pruned bushes, and it is usually accepted that low pruned bushes give poorer quality tea than those which are high pruned. The part of the shoot consisting of the bud and the first leaf is richest in tannin, and the leaf is richer than the bud, hence plucking immature leaf may lower the tannin percentage; also, the influence of the bud and first leaf may be lost if a number of coarser leaves are intermixed, as the tannin percentage decreases with age of leaf, as shown by the following data:—

	Moisture % —	Tannin % (on dry leaf) —
Bud	76.60	27.94 %
First leaf	78.60	27.94
Second leaf	76.80	21.34
Third leaf	76.90	17.84
Fourth leaf	74.80	14.50

The Single leaves are lighter in colour than the Burma leaves and are usually richer in tannin, which agrees with the accepted idea that light leaved bushes give better teas than dark leaved bushes. The seasonal variation in tannin content is considerable; in the case of the first leaves from Burma bushes plucked on May 26, August 4, September 1, and November 3, the tannin percentages were, respectively: 18.02 — 21.00 — 31.93 — 27.74.

In October there is a temporary falling off in tannin which cannot at present be explained. The general increase in tannin as the season advances has been recorded in the case of other tannin plants, especially the oak.
W. S. G.

383. Propagation of Rubber Trees by Budding.

Bulletin of the Imperial Institute, Vol. XX, No. 4, pp. 474-480, fig. 1. London, 1922.

On some plantations, records are kept of the latex yield from a large number of individual trees, and it has been found that most of the rubber is supplied by comparatively few high-yielding trees. It is obvious that economy would be effected by planting only high-yielding trees. The trees on the present plantations have been raised from seed, and very often without investigation as to the quality of the parent seed-trees. It is known that seedlings do not always inherit the good qualities of the parent trees, hence the only reliable method is that of vegetative propagation. The usual method is to make cuttings, but cuttings of *Hevea brasiliensis* do not root easily. Experiments in Java have shown that the

form of grafting known as budding is very successful, and that the resulting trees retain the quality of the parent tree.

Stocks. — Seedlings of *Hevea brasiliensis* are used for stocks and these should be raised from seed of high-yielding trees. The seedling plants should be spaced at least 2 feet apart in the nursery beds and the stocks are suitable for budding when about $\frac{1}{2}$ inch in diameter at 6 inches from the ground.

Buds. — The buds should be cut from the best-yielding trees only and it is advisable to obtain the buds from as small a number of mother-trees as possible, in order to obtain plants of a uniform type. From 700 to 1000 buds can be cut from one well-grown tree. The thickness of the bark of the bud should correspond as nearly as possible with that of the stock. Cleanliness is essential in all the operations.

The Budding operation. The operations of budding should be done in a definite order, somewhat as follows --

- 1) Clean the stock so as to remove any soil or grit.
- 2) Cut the bud from the selected piece of branch.

3) Make two vertical cuts in the stock and one horizontal cut and lift, and turn back the bark.

4) The stock is now ready to receive the bud. Cut the bark of the bud so that it is slightly smaller than the opening in the stock, then insert the bud so that the upper edge of its shield is in contact with the horizontal cut edge of the bark of stock. Replace the tongue of bark of the stock, after shortening, so that the bud is not covered.

5) Tie the whole together with a strip of waxed cloth put on like a surgical bandage.

The best time of year for budding is at the beginning of the rains, as during dry weather the bark is difficult to manipulate.

After treatment. — In about three weeks after budding the bandage should be removed and the loose tongue of bark cut off. After an interval of about ten days the bud should be examined and if on scratching the bark close to the bud it is found to be green and healthy, it may be assumed that union has taken place and the stock should then

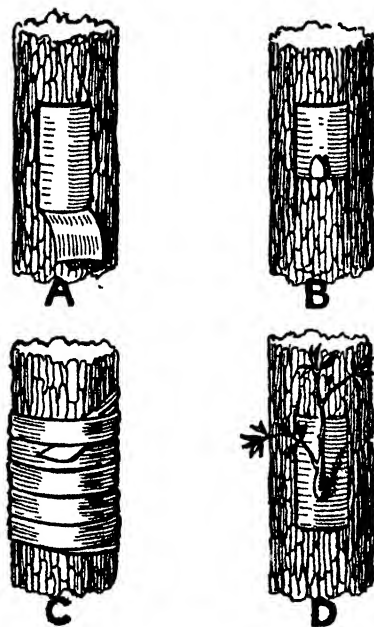


FIG. 83. — Budding of rubber trees.

- 1) Stocks having tongue of bark cut and turned back for insertion of bud.
- 2) Bud in position.
- 3) Bandage applied.
- 4) Bandage removed and graft growing.

be cut down to about 1 foot above the bud. If no union has taken place another bud may be inserted on the other side of the stock. Cutting back the stock may cause shoots to develop at the base of the stock, and these should be removed. In about six months the new shoot will have grown to a height of 3 or 4 feet, when the portion of stock left above the bud should be cut off and the wound covered with melted paraffin wax.

It has been found at the West Java Experiment Station that budded trees up to the age of four years develop a much larger number of latex vessels than seedling trees of the same age, also that they retain the characteristics of the parent trees. As it takes some years to prove the character of seedling trees much money would be saved by budding from high-yielding parent trees since these can be relied on to become high-yielders on reaching maturity.

In an article published by VICTOR RIS (*Arch. v. de Rubb. Ned-Indie*, p. 195, June, 1922) he deals with the influence of planting material and selection of soil on latex yields. It is considered that an estate now yielding 400 lb. of rubber per annum might have the yield increased to as much as 2000 lb. per acre by grafting selected high yielders on to suitable stocks. The quality of the soil also is so important that by suitable soil selection the yield of the rubber trees can be increased by 50 per cent thus making it possible to obtain 3000 lb. of rubber per acre per annum on an ideal estate. Taking into account the need for "resting", and other factors, it is estimated that 1200 lb. of rubber per acre ought to be reached on good estates.

W. S. G.

384. An Experiment made to ascertain the Movement of Latex in the Latex Vessels of *Hevea Brasiliensis* during Tapping.

VISCHER, W. Over een proef on de latex beweging in de latex vaten van *Hevea Brasiliensis* by het tappen experimenteel aan to tonen. *Archief voor de Rubbercultuur in Nederlandsch-Indië*, Year VI, No. 11, pp. 444-447, fig. 2, bibliography 5 publ. Buitenzorg, 1922.

The author wished to trace the source of the latex which flows down to the tapping-groove, also, how far away from the incision the latex is removed from the vessels and at what rate the flow takes place. According to ARISZ, the original latex derived from different parts of the tree show different melting points and by means of this principle he has tried to ascertain the place of origin of the flowing latex.

VISCHER found a diminution of pressure in the vessels up to a distance of one metre from the incision, which could not be explained other than by movement of the latex. BOBILIOFF has carried out experiments on trees with yellow latex (*Archief v. d. Rubbercultuur*, V, p. 95, VI, p. 62 and 112).

The latex of some trees becomes yellow after it has been in the vessels for some time, although newly formed latex is white. The author adopted the same method as BOBILIOFF. Trees were chosen in which the boundary-line of the white latex and the yellow latex occurred at the place of grafting.

Experiment *A* made on a tree grafted at a height of 35 cm. Colour of latex above the point of grafting before the incision was made : yellow.

Trunk : *A*, 5 cm. below the union, white, after repeated incisions;
 " *B*, 12 cm. " " " " after 5 minutes *B*, slightly yellow;
 " *C*, 20 cm. " " " " " 10 minutes *C* yellow;
 Incision, 30 cm. " " " " " 15 minutes incision yellow.

The yellow latex has thus taken 15 minutes to travel a distance of 30 cm. Also, immediately after making the incision, the latex at a distance of 30 cm began to flow towards the incision

Experiment *B* on a tree grafted at a height of 45 cm. Colour of latex above the place of grafting : yellow, before making the incision.

Below the place of grafting :

A, 5 cm. below the union, light yellow;
B, 10 cm. " " " white;
 Incision 40 cm. below the union white.

After repeated incisions :

A, after 2 minutes, begins distinctly to turn yellow;
 " 5 " as yellow as the main trunk,
B, " 20 " " " " "
 Incision 30 " yellow.

This experiment shows also that, where the incision is open the latex begins to travel towards the incision and starts from a distance of 40 cm., and that latex found at a distance of 40 cm reaches the incision in 30 minutes

In these experiments, the tapping was begun from below and continued in an upward direction, contrary to the usual method, because it is easier to note the moment of arrival of yellow latex, than the gradual bleaching of the yellow latex

It is obvious that it is immaterial in which way the movement of the latex is proved.

The results of these experiments are of practical importance because they show that when tapping takes place at a short distance from the soil, the latex vessels of the lower part of the trunk have an influence on production.

It is evident that the effect of a place in the internal bark which is affected by browning will be shown all the same, although the tapping may have been made at a relatively great distance.

D. V. S.

385. Tobacco Cultivation in Jugo-Slavia.

STAIC, UROSCH *Coltivazione dei tabacchi nella Jugoslavia. Bollettino Tecnico del R. Istituto Sperimentale per la Coltivazione dei Tabacchi Scafati*, Year XIX, Nos. 3-4, pp 231-233. Scafati (Salerno), 1922.

Tobacco was introduced into Jugoslavia at the time of the Turkish rule and, as it was evidently suited to prevailing conditions, the cultivation area was extended without delay and is now an important crop, and maintains its popularity.

The chief centres of cultivation correspond with the more important vine areas, namely in *Servia* at Bajina Besta ; Moravia (neighbourhood of Zitzkovatz and Alexinats), Rassina (neighbourhood of Kruscevat); Vragno, Kumanovo, Skopho ; Bregalnitz ; Prilip ; in *Herzegovina*, neighbourhood of Trebigno, Stolat, and Ljubuski ; in *Bosnia*, the entire country, especially near Vrgoratz. In Voivodina (Banato and Backa) and in Slavonia, tobacco is also grown to a considerable extent. In Slavonia preliminary trials were made in 1920, but since then results have not proved very encouraging, probably due to unsuitable climatic conditions.

The best quality tobacco comes from Skoplie, Bregalnitz and Herzegovina.

Two grades of tobacco are grown : small leaf and large leaf. The first is used only for cigarettes, is of Turkish origin and resembles the Turkish tobacco ; sweet taste, fine, light colour, very scented ; 3 % maximum of nicotine. This type is grown in the district south of the Sava and Danube rivers not including Bosnia and Herzegovina. In Dalmatia equal quantities of both small and large leaf tobacco are cultivated.

The small leaf type is classified as follows :

1) Long-stalked : " Golodranken " with distinctly petiolate leaves ; " Porsucian " without petiole.

2) Nearly sessile : " Guscian " and " Guscianato ".

The latter type is the most common and several different varieties are grown. The " Guscian " is the most suitable for the climate and gives a more satisfactory yield. It is preferred to " Porsucian " which decreases in popularity.

The cultivation of long-stalked tobacco is confined chiefly to the Voivodina district and to Slavonia. The leaves measure about 50 cm. length and 35 cm. across, strong flavour, useful as pipe tobacco but can also be mixed for cigarette purposes.

The war has seriously affected the tobacco industry in Jugoslavia and reestablishment of normal conditions is slow owing to the economic necessity of reserving wide areas solely for cereals. F. D.

386. Comparison between the chief Types of Tobacco in Deli (Dutch East Indies).

JOCHEMS, S. C. J. Onderlinge vergelyking van de voornaamste typen van Deli-tabak. *Mededeelingen van het Deli Proefstation to Medan Sumatra*, Series 2, No. XXV, pp. 1-37, plates 6. Medan, 1923

During the last 8 years, there has been no alteration in the system of tobacco selection employed in Sumatra (Dutch East Indies). Recently, however, a new method for measuring the length and breadth of the leaves has been introduced. Hitherto, measurements and enumerations were made of the leaves on the plant, and as marked variations are liable to occur, it was necessary to record at least 100 plants for each type. To ensure a reliable basis on which to work, this method involves the measurement of an enormous number of leaves in a limited time — a difficult proceeding under tropical conditions. The new method consists of a simpli-

fied system of collection and measurement of leaves on a board subdivided into half-centimetres.

It is estimated that a quick-worker can measure 1500 leaves in one morning. The inconvenience of this method is that the leaves when collected, have not yet reached their maximum development. The types differ in this respect; the author has therefore made investigations as to the results of a cross between a slow growing type with a quick-growing type. Measurements were made of the leaves beginning from 8 days previous to harvest and continuing for 6 weeks. It was observed that a leaf from a slow grower is limited to an increase of $\frac{1}{2}$ cm. length and breadth after ripening and from a quick-grower, the size remains stationary. The shape of the leaves is regulated by the rate of increase in size. The length and breadth enlarges from base upwards; from the tenth leaf, the increase is less obvious except that the length is elongated in proportion to the breadth.

Taking into account the possible errors liable to occur when measurements are made just before maturity, the new method is preferable owing to the large number of measurements of which it allows.

A detailed description is given concerning the appearance of the 7 different lines, the chief sources of seed in Deli, the number of leaves, the date of flowering, and the position of the leaves on the stem which comprise the chief points of difference. The author states that the 7 lines described are undoubtedly 7 distinct types.

As regards shape of the leaves three sets of observations were made: 1) the 3rd and 4th leaf; 2) the 5th and 6th; 3) the 9th and 10th; in each case for each line, 1500 leaves were examined and measurements taken. The results are tabulated and the number of leaves per plant of the different lines is given, which varies from 22 to 43, and also the height of the plants (to the uppermost blossom). The tallest plants are invariably associated with the greatest number of leaves.

In order to determine the influence of the density of leaves on the fineness of structure and on the quality of the tobacco, further counts were made of the leaves at a height of 3.2 ft., collected immediately before the harvest of the first leaf and directly after the harvest of the eighth leaf. The differences due to growth of the stem are negligible and as a rule the number is invariable.

Measurements of stem thickness at different heights above soil level are noted. The author doubts if there is any correlation between this thickness and the leaf yield. The number of leaves may be considered rather as related to the date of flowering. Late flowering results in a greater quantity of leaves.

The characteristics of practical value are the superior yield, colour and quality of the fermented produce and the combustibility.

The line which possesses the greatest number of qualities should be cultivated on a large scale. A comparison should therefore be made of the qualities of the fermented product and the plants in the fields. The author states that one line especially has shown a superiority to many other types. The quality of the tobacco is superior, the colour is attractive,

the leaf surface is good, the average number of leaves per plant and more especially the total yield per field is distinctly higher. The number of leaves varies from 33 to 43, average 36.7 i. e. 4 leaves more than the line following and they are 1 cm. more in length. An economic advantage in practice is the slow rate of ripening of this type, in consequence of which the harvest is not hurried.

Three other types, each with special characteristics have been proved to be suitable for cultivation, but these are more exacting as regards soil. Experiments relative to this fact will be made during the coming years.

D. V. S.

387. Cultivation and Production of Cinchona (Quinine).

I PIERAERTS, J Le Quinquina Congo, *Revue générale de la Colonie belge* Year III, Vol II, No 5, pp 667-806

II *Indian Trade Enquiry, Drugs and Tanning Materials, Imperial Institute* Report of Cinchona Bark, pp 1-40, tables XII + Statistics London, 1922

III. SANDS, W A (Assistant Economic Botanist Dept of Agriculture, Federated Malay States), The Cinchona (Quinine) Industry in Java *The Malayan Agricultural Journal*, Vol X, No 3, pp 65-86 Kuala Lumpur, F.M. S., 1922

I. — A detailed survey of all aspects of cinchona bark cultivation, origin, species, medicinal value, followed by an account of the results obtained with specimens of *Cinchona succirubra* Pav at the "Direction de l'Agriculture au Jardin botanique d'Eala" (Belgian Congo).

The chief source of quinine, namely the Dutch Indies cannot cope with the ever increasing demand, and attempts to extend the cultivation are being made in other countries, such as China, Brazil, Madagascar, Jamaica, etc. to supply local needs.

Analyses of Bark from Cinchona succirubra at Eala.

	Moisture		Dry Matter		Total Ash		Total Alkaloids		Alkaloids soluble in ether		Quinine sulphate	
	Single stock	Several stocks	Single stock	Several stocks	Single stock	Several stocks	Single stock	Several stocks	Single stock	Several stocks	Single stock	Several stocks
Bark from branches	10.55	10.15	89.45	89.85	7.38	3.46	6.95	6.53	6.70	5.58	2.32	2.45
Residue from branches	10.27	10.32	89.73	89.48	3.65	7.26	7.11	5.39	7.23	5.15	1.64	0.83
Residue from twigs	11.30		88.70		7.70		5.45		4.03		1.59	
Bark from roots	9.30	10.15	90.70	89.85	3.61	4.09	7.26	6.45	6.36	5.65	2.35	1.67

The bark obtained at Eala is evidently of superior quality and indicates the adaptability of *Cinchona succirubra* to the climatic conditions of the Belgian Congo and the importance of making further cultural trials with a view to the stabilisation of this species, which after a few

years should supply 800-900 kg. of quinine sulphate per annum and meet the local demand.

II. — Report of the Indian Trade Enquiry dealing with cinchona bark cultivation, production, trade and utilisation throughout the world. Attention is drawn to the fact that at present Java produces about 23 000 000 lb. of bark, that is, 90 % of the total world's production, and the possibilities of increasing the production in India and Africa (including full statistics as to exports etc.) Cinchona bark produced in St Helena, East Africa and in the Cameroons has recently been received at the Imperial Institute, London, and chemical analyses made of *Cinchona robusta*, *C. succirubra*, *C. Ledgeriana* and *C. Ledgeriana* × *C. succirubra* together with an account of the methods of cultivation in these countries.

III. — W. A. SANDS gives a detailed description of the gradual increase in cinchona bark production in Java, the acreage planted, the species, etc. cultivated, and the methods employed. The remarkable success obtained is due chiefly to the careful selection and propagation, largely, of *Cinchona Ledgeriana*, the regulation of market prices, the plentiful supply of cheap labour, the ideal conditions of soil etc., and the valuable experimental work of the Government Cinchona plantations.

The author gives the exports of quinine sulphate and bark from the Dutch East Indies for the years 1916-20. The average annual production is estimated as follows:

1st Year	125 lb. dry bark.	5 % quinine
2nd "	250 " " "	6 1/4 % "
3rd "	375 " " "	7 % "
4th "	500 " " "	7 1/2 % "
5th "	630 " " "	8 % "

An examination of the alkaloid content of *C. Calisaya* and *C. Ledgeriana* shows the outstanding superiority of the latter as a source of quinine. The annual increment of quinine in the bark is studied closely in the selection and observation gardens, and samples of stem bark are taken each year from each type grown and analysed. It is a noteworthy feature that the quantity of quinine contained in the bark is not the same, even when the grafted trees are all derived from one parent tree and grown near to each other under similar conditions.

A description is given of the method of marketing and extraction of quinine. M. L. Y.

Vine growing.

388. Influence of Vine Training on Fruit Production.

AUCHTER, E. C. and BALLARD, W. R. *Bulletin No. 250 University of Maryland Agricultural Experiment Station*, pp 207-234, figs 22, bibliography. College Park, M. D., 1922.

Records of yields obtained from different varieties of vines trained according to five systems at the University of Maryland Agricultural Experiment Station viz. — Single Stem Four Cane kniffen, Single Stem

Two Cane kniffen, Two Wire Umbrella or Umbrella kniffen, Munson 3 wire cross-bar system, and the Fan.

Under Maryland conditions, the Single Stem Two Cane kniffen appears to be the most satisfactory method. Posts are set 24 ft. apart, 3 vines between each two posts and no vine nearer than 4 ft. from any post. The lower wire is placed 2 ½ to 3 ft. from the ground and the upper wire from 2 to 3 ft. above the lower one. First year, the cane is pruned back to two or three buds, and the shoots staked or allowed to trail. Second year, all canes but one are removed and this is cut back to two or three buds. Third year, all canes but one removed and this should be carried to top wire and secured; all shoots should be retained, the excess canes can be removed at the next pruning, giving the vine the advantage of their growth during the summer. Vines pruned thus, often have the most vigorous shoots near the head. Fourth year: two vigorous canes selected just below the lower wire and trained to right and left along the wire, shortening back to 4 buds; a similar system is followed along the upper wire shortening back to about 6 buds. Two more canes are cut back to spurs close to the main stem at each wire, and only one or two buds left. From such renewal spurs, canes for training along the wires will be developed for the following year. All other canes should be removed. Fifth year, training similar to fourth year system. In selecting the canes it is advisable to choose the round, medium sized ones, with average internodes and round buds. It will probably be profitable to select spurs on wood older than two years as shoots on such wood seldom bear fruit and will make good fruiting canes the next year. Canes on the upper wire should be cut back to about 10-12 buds, and the forthcoming fruit bearing shoots allowed to droop down without tying. The number of buds to leave each year will depend on several factors but good vigorous, mature vines growing on average soil should show 30 to 40 buds, i. e. 60 to 80 clusters of grapes.

The yields obtained per acre are distinctly higher with this system than with the others giving high grade fruit. The Munson system also gave good yields but the additional expense and time required for erecting the trellis, and the greater difficulties of picking and spraying make this method inferior. The three other less profitable systems of training are also described in detail, also several other less common methods applicable to weak growing varieties, when it is an advantage to train the shoots upright.

M. L. Y.

38) Hybridisation of the Vine.

I — ZWHEIGELT (Leiter der staatlichen Rebenzüchtungsstation in Klosterneuburg) Rebenkreuzungen. *Allgemeine Weinzeitung*, Year 39, No. 44, p. 167, No 45, pp. 171-172. Vienna, 1922.

II — IDEM. Die Technik der Rebenkreuzung und die heurigen Ergebnisse im Lichte derselben. *Ibid.*, No. 50, pp. 193-194; No 51, pp. 197-199 No. 52, pp. 203-204.

I-II. — A description is given by the author, Director of the "Rebenzüchtungsstation" (Vine Breeding Station), at Klosterneuburg (Lower

Austria), of the crosses made in 1922, including 100 known varieties, and of 45 self-pollinated varieties. Amongst the cross-pollinated varieties may be mentioned: White Burgunder Neuburger; Orange Träube; Grey Portugieser; Red Veltliner; Blue Portugieser; White Riesling; White Gutedel; White Welschriesling (Oesterreichisch); Rotgipfler (Blaufränkisch); St. Laurent; Red Ziefandler, Red Sylvaner; Green Sylvaner; Blue Wildbacher; Red Traminer. These crosses should give superior quality fruit.

As a substitute for cross-pollination of various vines with pollen from the stock *Berlandieri Riparia Kober B* and *Berlandieri Riparia Kober 5 BB*, it is considered probable that better results will be forthcoming with the stock used in Lower Austria, the most popular stock being the Green "Veltliner", suitable for calcareous and most other types of soil.

F. D.

390 A New Method of Grafting Vines.

BRICHET, P., Une nouvelle greffe pour la vigne *Le Progrès agricole et viticole*, Year 44, No. 2, pp 31-33 Montpellier, 1923

The author has introduced a new method of budding as a substitute for the "Mayorquine" system. The graft consists of a shield shaped bud which is inserted in the upper portion of the stock in an oblique cut.

This method can be employed *in situ* and with a small scion, but it will in such a case be advisable to cover the tip with paraffined paper to avoid drying.

The following advantages are noted: The shoot is an extension of the stock and will develop into a rectangular form. The union is complete and the graft grows more quickly as a consequence of the direct union of the cambial surfaces. The dead wood is reduced to a minimum and the callus formation is rapid. This method causes a distinct saving of labour.

R. D.

Forestry.

391 Crop Rotation as applied to Forests.

ROULLEAU DE LA ROUSSE, *Bulletin du Comité des Forêts*, Year X, No. 1, pp. 318-326 Paris, 1923

In the author's opinion foresters in the past were not opposed to the idea of changing from time to time, the species growing in the forests. They were, however, more inclined to introduce types growing on the same soil, which is in itself a form of rotation, on account of the difficulties and cost of a more complete system. The Department also seems to have considered the economic more than the cultural side and has at times gives orders which were harmful and not in accordance with the theory of crop distribution. Thus in 1855, when oak wood was very expensive, orders were given to eradicate beeches from the oak forests.

The author advises an alternation of species, but it should not be carried out roughly or on hard and fast lines. If a forest has not been too much

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damaged by bad clearances or bad general management, the greatest efforts must be made to maintain on the soil the kinds which have always thrived there.

It is only in exceptional circumstances that the immediate or progressive substitution of groups of trees can be considered. For example: the order given to destroy most of the beeches in the forest of Sercé, situated on acid siliceous soil, speedily ruined several of its oak plantations. After the disappearance of the beeches the heather began to spread and invade the undergrowth, but when this was removed, the author saw innumerable vigorous clusters of oak-seedlings springing up. From 1885 to 1910 a regular campaign was carried on against the encroaching heather. It was all up-rooted and beeches planted between the large clusters of oak-seedlings. His efforts were useless and henceforward a rotation with silvan firs has become a necessity.

In forest coppices rotation of species takes place naturally in many places, but in many others, artificial rotation has often to be drastically applied.

For example the case may be taken of a forest where the oak-tree was supreme in former days, intermingled with a few birches and aspens. The "white" disease attacks the oak-tree almost every year from 1909 onward; birches and aspens are spared, and within a short period they spread all over the wood. The hornbeam is a species which, in the vicinity of oak-trees suffering from "white" disease, has the same effect as the birch and aspen.

The hornbeam seeds very profusely every year, it is therefore difficult to maintain beeches and oaks where this species has established itself. But the hornbeam coppices are finally destroyed and supplanted by aspens and under the aspens, the oak-tree naturally returns. This therefore is a case of natural rotation of species.

But if the soil has lost its fertility, birches and heather will take the place of the oak-tree and an artificial rotation with pines will be required.

Natural rotation works slowly and to hasten its progress, the simple coppice or the old and completely spoilt, oak, beech etc. coppices, can be replaced by fir-trees from the Jura, forest-pine, larches or green Douglas. At Laigle (Orne) and elsewhere, coppices were transformed into fir forests in less than a century, since the forest-pine grows in 30 years. A less radical method can also be adopted. In a completely ruined deciduous forest of birches from 20 to 25 years old and thinly distributed, the author had planted groups of resinous trees (2 plants of Normandy fir at 2 points per hectare) a form of plantation that entails practically no expense and is convinced that in about 80 years, without any further cultivation, the firs will have fertilized the coppices in large patches, and that for 150 years, the forest will be marketable. The following example corroborates this view: 130 years ago, the forest coppices of the estate of Arlay in the Jura, did not contain a single fir-tree and were worthless. At a certain time, the fir-trees of the commune of the "Haute Joux" spread their seeds abroad and the fir seedlings were allowed to develop. To-day the last traces of the coppice have disappeared. The author advises that the beech

shoot of the staddle kind which are found there and are very vigorous should not be disturbed. Thus will be obtained a rotation of species, with fir trees and beeches in combination.
R. D.

392. Forest Management in France.

SCHAEFFER, A. (Conservateur des Eaux et Forêts). Development of (French) Management Methods from 1912 to 1922. *Journal of Forestry*, Vol. XX, No. 8, pp. 883-887. Washington, 1922.

The period under consideration was almost entirely occupied by the War which, owing to the enormous demand for wood it occasioned, increased the necessity for transforming coppices into forests. On the other hand, the War proved that forests, whether of conifers or deciduous trees, were able to provide rapidly, trunks of large dimensions without affecting their future utility. The coppices beneath standards, on the other hand, only supplied materials for making small objects or charcoal. Their large reserve trees could not be removed without causing damage, while the necessity of cutting down the coppice in order to reach these reserves has always been a difficulty. Further, the great disproportion between the areas occupied by coppice under tall trees and the cubic measure of large timber obtained from it has led to the condemnation of this method of forestry in France.

The conversion of coppice into high forest, however, necessitates an expenditure of time and money that cannot be met by private individuals. For this reason, a system intermediate between the coppice and high forest was devised, which goes by the name of the "selected deciduous high forest" ("futaie jardinée feuillue").

The tendency of the new methods is towards more frequent felling, the leaving of large reserves (in order to increase the production of heavy timber) and the gradual substitution of regeneration by shoots for reproduction by seed.

In a forest divided into 30 felling lots, 2 fellings are made annually, so that every 15 years, each lot is subjected to a felling which is at the same time a selection thinning. Trees of an age to be used as timber, as well as defective specimens, are cut down, the groups are thinned and the development of valuable species attended to. The felling, however, is limited in such a manner that before the next cutting, the forest has regained its original density.

Let V be the volume before the felling, x the fraction exploited, t the amount of growth and n the number of years of the period under consideration. We then obtain the following formula (based on the formula of compound interest): $(V - Vx)(I + t)^n = V$; whence we have:

$$x = 1 - \frac{I}{(I \pm t)^n}.$$

If we consider the average trees with an increase in size of about 3%, and take a period of 15 years, we get: $x = 1 - \frac{I}{1.03^{15}} = 0.36$.

In this case, if 36 % of the reserve is used, this is renewed at the end of the 15 year period.

If the object is to enrich the forest, the staddles need not be counted in the estimation of the initial volume, or else an increase of, for instance,

$\frac{1}{5}$ of this volume may be aimed at in 15 years. The formula then is

$$(V - V_x (I + t)^n = V + \frac{V}{5}.$$

With $t = 3$ and $n = 15$, it is seen that the felling should be limited to 27 % of the reserve volume. This estimate is important, for it gives the owner information respecting the future of the forest he is exploiting and prevents impoverishment. The advantages of this system, which has already been adopted in the case of numerous communal forests are, further, as follows :

Frequent cutting at the same place insures the vigorous growth of the young shoots ; even immediately after felling, the spaces between the large trees are of small extent, so that the soil is always occupied. Finally, the trees grow more nearly to the same height which increases the yield of large timber and decreases the amount of lopping required.

When the coppices under high forests are situated at an altitude of over 400 m., conifers are usually planted, these trees produce 10 cubic metres of saw-timber per annum and per hectare, whereas deciduous trees never yield more than 4 metres. The yield of the Douglas fir at this height would probably be even more, although in low-lying districts like Sologne, this tree has not been able to resist the draught of the last few years.

R. D.

393. Logging in North-West America (British Columbia and Pacific States).

KAY, J. *Transacion of the Royal Scottish Arboricultural Society*, vol XXXVI Pt. II, pp. 152-157, figs 10. Edinburgh, 1922.

The development of forest areas inaccessible by ordinary means of timber transport has necessitated the adoption of new methods of handling and transport. Hence the construction of flumes, chutes, etc. Flumes can be constructed more cheaply than a railroad and can be worked without fuel or skilled labour. The first stage in flume construction consists in an accurate survey of the proposed line of flume, the best grades, curves, and probable cost. The grades may vary from 1 % to 25 % or more ; 2-6 %, grades are, however, the most efficient. The available water-supply will determine the type of flumes and whether square or V-shaped. The latter type is considered the best. The water is confined and has the greatest carrying power owing to the shape and tends to lift the log, and is less likely to cause a jam ; also, this system requires less water than the other types. The 90° angle seems the best for all purposes. The usual procedure is to erect a saw-mill near the upper end of the



FIG. 81 - The sap tree rigged ready for yarding and loading by means of two donkey engines

flume, and to saw out the material required; as the work proceeds the lumber is floated down as required. In the autumn when the water becomes scarce, use is made of an iron apron which acts as a dam and keeps back sufficient water to give force enough when released to set the logs going. A telephone line is usually carried along the flume; when a jam occurs word is quickly passed down to the skidding crews and loading is stopped and the water turned off until the obstruction is removed.

In the early years of the lumber industry on the Pacific Coast beasts of burden were largely used for skidding purposes. Owing, however, to the size of the timber, and the topography, other means of transport were found to be necessary. Near the coast, logging railroads have been constructed. The locomotives used are mostly geared, which enables them to climb heavy grades up to 7 % or more. The fuel used may be oil, coal or wood, depending on circumstances. The wagons are very strongly built and are supplied with automatic couplings, air and hand-brakes. Felling and cross-cutting are still done by axe and saw, but the old trees are often swell-butted and spring-boards are used to reach the point above the swelling which prevents slipping on sloping or soft ground.

In British Columbia the high-lead system is more common. The logs are hauled to the side of the railroad where they are loaded on the wagons; when the train is filled it is replaced by a new line of empty wagons. Spar trees are left at distances of 1000-1200 ft apart and about 12-15 ft. from the railroad. The rigger climbs the tree and at a height of 120-200 ft., lops off the top with axe and saw (lately, this has been done in some cases by stringing together several sticks of dynamite and placing around the tree top, and firing the charge by means of a detonating cap attached to a long fuse). To give rigidity to the spar tree, 6 cables are placed near the top and 3 near the middle; a high-lead block weighing 500-900 lb. is then hung 5-15 ft. below the cables, and is fixed to the spar-tree by means of a 1 ½-2 inch plough-steel strap. The loading tackle is also installed before the rigger descends from the tree (See Plate XXV, Fig. 84). Two donkey engines are used, one for yarding (skidding), the other for loading. These are operated from one massive platform and are expected to haul and load logs often 10 ft. in diameter and 32 ft. or more in length. They are equipped with high-pressure vertical boilers and have a working pressure of from 150-200 lb. per sq. inch. A detailed description is given of the methods of transportation. Two main drums are placed tandem fashion on the platform; these carry the main hauling line and the trip line (haul back). The latter is a small wire rope travelling between the power-skidder and a pulley to be dragged and used to return the main cable with chokers, etc. for the next log. The main yarding line varies from 1-1 ½ inch in diameter and from 900-1500 ft. in length and is made entirely of steel. A third drum carries the straw line and is used to run out the trip-line, or as a haul-back, either when a new setting is being made or when roads are being changed. The "Wentworth" patent core-rope is said to be the best wire rope used in British Columbia; this prevents the strands from crushing each other, and consequently does away with in-

ternal friction that wears away the individual wires of the strands. Trip lines are $\frac{5}{8}$ - $\frac{3}{4}$ inch in diameter and about 2 $\frac{1}{2}$ times as long as the main yarding lines. An electric signal is used for transmitting orders.

R. D.

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394. MUNDY, H. G. (Chief Agriculturist and Botanist). Distance Planting Trials for Maize. *Bulletin* No. 440, *Department of Agriculture, Rhodesia*, p. 11, Salisbury, 1922.

The trials show that the best yields of grain have resulted from the spacing of 40 ins. between the rows and 15 ins. between plants in the row. When the crop is required for fodder, closer planting is advantageous.

W. S. G.

395. PERCIVAL, Prof. J. Seed Mixtures for Permanent Grassland. *Journal of the Ministry of Agriculture*, Vol. XXX, No. 3, pp. 204-209. London, 1923.

Comparison between the chief methods commonly employed for the production of permanent grass on arable soils: 1) tumble down pastures (random herbage); 2) sowing of hay seeds (from barns and haystacks etc.); 3) use of seed mixtures of commercial grass and clover seeds. The advantages of a complex mixture are discussed and a list of useful mixtures on light, medium and heavy soils is given including details as to preparation of the land and sowing.

M. L. Y.

396. RIVIERE, G. (Directeur de la Station agronomique de Seine-et-Loire). PICHARD, G. Influence de la Couleur des murs d'espaliers sur la hâtivité de maturité des Fruits des pêchers qui y sont adossés. (Effect of Colour of Wall upon Ripening of Fruit of Espalier Peach Trees). *Journal de la Société d'Horticulture de France*. Series 4, Vol. XXIV, pp. 79-82, Paris, 1923.

The fruit of peach-trees trained as espaliers against a black wall ripen much earlier than that of similar trees trained against a white wall; this is explained by the difference in the average temperatures which have been found to be 24.08° C. and 18.81° C. respectively from March 6 to September 8.

R. D.

397. SICARD, H. Moyens pour remédier aux dégâts causés aux vignes par l'orage (Means of Remedying the Injury done to the Vines by the Hail-Storm). *Le Progrès agricole et viticole*, Year 40, No. 6, pp. 129-137, Montpellier, 1923.

The author examines the question whether it is advisable in some cases to re-prune vines injured by hail, and treats of the best method of gathering the grapes from vines that have been repruned and those that have only been pruned once.

R. D.

398. REYES, LUIS, J. (Forester and Wood Technologist, Bureau of Forestry, Manila). Woods of the Philippine Dipterocarps *The Philippine Journal of Science*, Vol. 22, No. 23, plates 31, pp. 291-344. Manila, 1923.

Anatomical and technological studies on the woods of various species of *Dipterocarps* in the Philippines. R. D.

399. DUYFJES, J. J. Een kyk in vogelvlucht op het boschbeheer op Java 1911-1920. *Tectona*, tome XVI, No 1, pp. 1-6. Buitenzorg, January 1923

A summary of the management of the forests in Java in the years 1911-1920. An examination of the output of teak-timber and the financial results (net-income) of the forest management in the whole of Java as well as in specified areas of that island. D. V. S.

400. LUGT, C. Producten boekhouding voor het boschbeheer op Java. *Tectona*, Vol. XV, No 12, pp. 1021-1048. Buitenzorg, 1922.

An article on accounting in forest administration in Java. D. V. S.

401. BECKING, W and J H Ennontwerp voor de hontboekonding in de Djati bosschan op Java *Tectona*, vol XV, No. 12. pp 1049-1069. Buitenzorg, 1922

Accountancy system for the teak forests of Java. D. V. S.

LIVE STOCK AND BREEDING.

SYNTHETIC ARTICLES.

402. The Value and Use of Certain Stock Feeds.

I. — KLING H. (Landwirtschaftliche Kreis-versuchstation Speyer). Einige häufig vorkommende Weinbergunkräuter, ihre chemische Zusammensetzung sowie ihr Wert als Futter- und Düngemittel. *Wein und Rebe*, Year 4, Part 7, pp. 311-326. Mainz, 1922.

II. — Fish Meal as a Food for Live Stock (*Ministry of Agriculture and Fisheries, Leaflet*, No. 333 (Revised, November 1922). London.

III. — PREIFFER TH. Die Stickstoffhaltigen Verbindungen nichtei-

weissartiger Natur in Futter. *Fühlings Landwirtschaftliche Zeitung*, Year 71, Parts 17-18, pp 313-324. Stuttgart, 1922l

IV. — RICHARDSEN AND BRINKMANN. Milchviehfütterungsversuche mit Harnstoff *Ibidem*, pp. 325-334.

V. — ENGELS Die verschiedenen Methoden der Grünfütterung verwertung resp. — Konservierung unter besonderer Berücksichtigung der Rübenblätter and sonstigen Blattarten. *Süddeutsche Landwirtschaftliche Tierzucht*, Year 17, No. 25, pp 299-203. Hanover, 1922.

VI. — FRAPS, G. S. Digestibility of the Sugars, Starches, Pentosans, and Protein of Some Feeding Stuffs. *Ibidem*, No. 290, 21 pp 1922.

VII. — FRAPS, G. S. Digestion Experiments. *Ibidem*, No. 291, 15 pp. 1922.

VIII. — WHEELER, G. B. The Marketing of Mill Feeds. *Ibidem*, No. 1124, 1922.

I. — *The composition, and the stock-feeding and manurial value of some common vineyard weeds.* — In the vinegrowing regions of the Palatinate, and especially in the highest parts of the Haardtgebirge, vineyard weeds are used as a stock feed, being fed alone or with pruning débris. The author analysed some of these plants and obtained the results given in the appended tables. He took as terms of comparison the composition of meadow hay shortly before flowering, and that of Red Clover in full flower. These two feeds contain respectively: dry matter 25 — 21 — 24; the dry matter being composed of: crude protein 12.0 — 16.2 — 16.2; fat 3.2 — 3.2 — 3.3, N-free extract 52.4 — 44.8 — 38.8; crude fibre 24.0 — 28.1 — 32.5.

The percentage of dry matter in the weeds studied ranged from 7.34-16.90, being below that found in meadow hay, red-clover and lucerne, but the sand-freed dry matter contained larger quantities of protein (17.31-27.78 %), fats (1.39-4.55 %) and crude fibre (13.25-19.68 %) than the last mentioned three plants; the percentage N-free extracts was, however, lower in the weeds (30.45-46.55). Thus, from their greater succulence, weeds fed green are of less value than fresh meadow hay, red clover and lucerne, but of greater value than these hays if fed dry.

The weeds under consideration withdraw from the soil large quantities of nutritive substances which must be carefully restored to the land,

Hoeing is the best method of controlling these weeds; should they, however, get the upper hand, they can be used as forage, but must not be cut too near the ground (in order to obtain them clean), and ought to be washed before they are given to stock. Any plants known to be injurious are naturally discarded.

The weeds studied all suited animals very well with the exception of *Mercurialis annua* which is always left untouched by grazing stock and rejected if mixed with hay. Owing to their large nitrogen and potash content (which reaches the very high figure of 10.9 % of the dry matter in *Chenopodium album*), all these weeds have a considerable manurial value.

TABLE I. — *Percentage of the chief forage constituents present in the weeds.*

Weeds	Dry matter in the weeds when first cut	In the sand free dry matter							
		Crude protein	Pure protein	Fat	N-free extract	Crude fibre	Ash	Phosphoric acid	Lime
<i>Convolvulus arvensis</i>	16.90	22.60	13.64	3.48	42.35	19.68	11.89	0.94	1.87
<i>Chenopodium album</i>	11.22	24.95	15.47	2.18	32.07	15.75	25.05	1.33	3.61
<i>Stellaria media</i>	9.22	24.08	16.16	2.05	38.18	14.93	20.76	1.66	1.99
<i>Cirsium arvense</i>	11.79	21.03	12.19	1.95	39.23	19.16	18.63	0.89	5.30
<i>Sonchus oleraceus</i>	9.39	19.94	12.54	4.49	40.69	15.55	19.33	1.12	2.92
<i>Mercurialis annua</i>	12.00	23.88	15.01	3.39	38.55	17.13	17.05	1.19	4.05

TABLE II. — *Percentage of substances nutritious to plants, present in the dry matter of weeds.*

Weeds	Nitrogen	Pho-phoric Acid	Potash	Lime
<i>Convolvulus arvensis</i>	3.62	0.94	4.91	1.87
<i>Chenopodium album</i>	3.99	1.33	10.91	3.61
<i>Stellaria media</i>	3.85	1.69	10.93	1.99
<i>Cirsium arvense</i>	3.36	0.89	5.48	5.30
<i>Sonchus oleraceus</i>	3.19	1.12	7.82	2.92
<i>Mercurialis annua</i>	3.83	1.19	5.89	4.05

II. — *Experiments carried out in Great Britain in order to determine the value of fish-meal as a food for live-stock.* — The annual production of fish-meal in Great Britain exceeds the internal consumption. Most of this meal used to be given to poultry, but of recent years, it has been increasingly fed to other domestic animals.

The general average of nine recent analyses has given the following minimum, maximum and mean percentages: moisture 7.7 to 18.1; 12.9; albuminoids (protein): 51.1 to 63.1; 56.6; — fat 1.3 to 6.7; 3.71 — mineral constituents 20.8 to 28.0; 24.9 (these figures include: calcium phosphate 16.6 to 20.6; mean 18.8 — salt 0.6 to 5.3; mean 2.2) carbohydrates, crude fibre etc., 0.3 to 4.2; mean 1.9.

As a general rule, fish meal should only form one eighth of the ration, and when employed as a stock-feed, ought to contain no herring débris, or salt. If these precautions are observed, the meat of pigs given fish meal is of excellent quality, but if this care is not taken, the pork acquires an unpleasant smell.

No detrimental effect on the appearance, colour, odour and culinary value was observed in the case of the meat of the pigs used in experiments

at Leeds University, where fish-meal formed $\frac{1}{6}$ to $\frac{1}{7}$ of the total dry food, being fed during the last month at the rate of over 0.5 kg. per head and per day.

In the pig-feeding experiments conducted at the Rowett Research Institute, of Bucksburn, Aberdeen, tests were made with:

1) Fish-meal especially prepared for a stock-feed from fresh salmon waste (analysis: albuminoids 61.1, fat 2.3; inorganic matter 25.0; moisture 10.3; undetermined 1.3 %).

Results: No disagreeable smell, or taste, was imparted to the fresh, or salted, meat, even when the pigs had been fed the meal up to the time of killing.

2) Fish meal made of a mixture of salmon and herring waste (analysis: albuminoids: 62.2; fat. 6.4; inorganic matter 13.6; moisture 14.6; indetermined 3.2 %). Proportion fed $\frac{1}{7}$ of the ration.

Result: the meat of these animals had a disagreeable smell and taste.

3) Various commercial fish meals sold under the name of "White fish meal". Amount fed $\frac{1}{8}$ of ration.

Result: no unpleasant odour, or smell, was imparted to the fresh meat, even when the pigs were fed this meal up to the time of killing. The salted meat, however, had an unpleasant flavour in the case of animals that had received fish-meal up to less than 14 days before they were killed. If the fish meal had been discontinued for 14, or more days before the animals were killed, their meat was not affected. It may therefore be concluded that meal made from salmon refuse may be fed up to the time of killing in the case of animals of which the meat is to be consumed fresh, and up to 3 or 4 weeks before the time of killing, if the meat is intended for salting.

Fish-meals 1 and 2 were given to dairy cows (0.9 kg. per head and per day for two months), and also to hens: the milk from the cows, and the flesh and eggs of the fowls were not affected in any way.

The fish-meal manufacturers of Great Britain have agreed to produce a meal made only from salmon refuse to be sold under the name of "White fish meal", and having the following composition: albuminoids not below 55 %; calcium phosphate not below 16 %; fat not above 5 % salt not above 4 %.

In three experiments made in 1918-20, at the West of Scotland Agricultural College, fish meal of the above given type was used for fattening cattle at the rate of 600 gm. per head and per day mixed with rolled oats. The animals fattened well and their beef was excellent. Up to 1.4 kg. of fish meal per head and per day may safely be fed to milch cows, but care must be taken that the milker does not touch the meal just before milking, otherwise the milk acquires a disagreeable smell.

Owing to its high albuminoid and phosphate content, fish meal is especially good for calves. Recent experiments have proved the advantage of rearing calves on whey and a mixture of fish meal and meal, or milling offals; one parts of fish meal and two parts oat meal or middlings being given, for instance. In some trials made at Reading, the following mixtures were given at the rate of 500 gm. per 5 litres of whey:

linseed cake + bean flour + fish meal (3:3:1); 2) linseed cake + fish meal (2:1); 3) linseed cake + oat chaff + fish meal (3:2:1).

Horses may be given up to 0.9 kg. fish meal per head and per day; fish meal is especially useful when good hay is lacking and much straw has to be introduced into the ration.

Fish meal also forms a very good supplementary food for sheep on roots, and can be given to them at the rate of 150 to 200 gm. per head per day, and per 100 kg. of live weight. It is well suited to suckling ewes.

Chicks must not be fed fish meal until they are at least a week old, when this meal may form 5 % of the mash, the amount being afterwards increased gradually. Young fowls, can be fed the following ration: crushed oats + chaff + maize flour + fish meal (8:8:2:1). Laying hens may be given 10 to 15 % of fish meal in their mash which may be composed, for instance, of middlings maize flour + chopped lucerne or clover, hay + fish meal (3:3:3:1).

III — *Non-albuminoid nitrogenous compounds for stock-feeding.* — Dr. PFEIFFER discusses the results of the extensive experiments conducted by HANSEN on feeding milch animals with a ration containing urea (1).

In the two series of experiments on dairy cows (in which urea was added to a ration poor in albuminoids, but containing sufficient starch values), the milk yield decreased little, or not at all, any slight decrease was attributed by HANSEN to a lack of easily soluble carbohydrates; PFEIFFER however does not discuss the matter.

The third series included 7 preliminary periods of 21 days each, and 14 periods belonging to the experiment properly so-called. In periods 1-3-5-7, the cows received sufficient albuminoids, but in periods 2-4-6, the latter substances were partially replaced by urea of equivalent starch value. Whereas during the first periods, the average live weight gain per head and per period was 7.75 kg., in the second series, the live weight decreased 3.33 kg. Hence, we have 11.08 kg. per head and 0.53 kg. per head and per day as the balance against the ration containing urea. In series 4, 5 and 6 of the experiment the balance against urea was respectively 0.62 — 0.14 — 9.77 kg. per head and per day. In series 7, a basal ration poor in albuminoids but containing sufficient starch values (period 1), was supplemented by urea (period 2) and by oil cake (period 3), in order to make its albuminoid content higher, and its starch value lower as compared with the two preceding series. In the urea period (8 days), the animals lost on an average 1 kg. per head, viz., 0.12 kg. per head and per day; in the oil cake period (12 days), they gained 9.5 kg. viz., 0.79 kg. per head and per day. Therefore, the balance against the urea ration was 0.91 kg. per head and per day. In the general averages of the series of experiments 3 to 7, the loss due to the addition of urea to the ration was 0.59 ± 0.88 kg. per head and per day.

This noticeable loss in live-weight can be explain by two hypotheses: 1) the tissues of the animals were consumed by the production of milk

which contained crude protein and albuminoids in excess of the amount supplied by the food, 2) some deposition, or loss, of fat had taken place; the urea had probably been transformed in the digestive apparatus, by the action of bacteria, into albumin with the expenditure of much energy and consequent transformations in the carbohydrates.

Taking the first hypothesis as his basis, the author has estimated the weight of milk corresponding to the animals' loss of weight; the amount of milk that could have been produced without any decrease in the live weight or any administration of urea + starch value and the amount of milk yield due to the urea + starch value. This latter amount was 35.5 % of the actual production, viz. less than 37 % of the milk supplied by a corresponding amount of albuminoids.

On the basis of these data and of the unit prices (as compared with that of urea), of various carbohydrate food-stuffs and of some oil-cakes, the author shows that the ration containing urea + starch value in part substitution of albumin costs more than the normal ration. Urea cannot economically be used as a food, but should be kept for a fertiliser, since the forage value obtained by its application is far higher than that of the same quantity of urea employed as a food-stuff.

IV — *Experiments in feeding dairy cows with urea.* — These experiments were conducted at the Higher School of Agriculture, at Bonn-Poppelsdorf. The basal ration consisted of straw, chaff roots and slices, in alternate periods, 200 gm per head and per day were given *in addition*. The results obtained were entirely satisfactory, for the addition of urea made a slight increase in the milk yield and the fat content, as well as in the weight of the animal.

V. — *The use and conservation of green forages and especially of the leaves of beets, etc.* — A brief account of the various methods of preserving green forages by means of drying and ensilage.

VI. — *Digestibility of the sugars, starches, pentosans and protein of some feeding stuffs.* — The work described by FRAPS in *Bulletin* No 290 of the Texas Agricultural Experiment Station is a continuation of the experiments described in *Bulletins* 175 and 196 of the same Station. The first *Bulletin* treats of the digestibility and distribution of pentosans in the foods, and the second of the digestibility of the sugars, starches and pentosans present in roughage.

In *Bulletin* 172 of the North Carolina Experiment Station (1900) the author has passed in review the literature dealing with this subject published up to the present year, while in the *Bulletin* under examination, some recent important researches carried out in the United States are described.

The material used in this work was obtained from the digestion experiments described in *Bulletins* Nos. 166, 203 and 245 of the Texas Experiment Station.

The determination of the pentosans included the estimation of both the soluble and insoluble forms present in the N-free extracts and in the crude fibre. The residual NT-free extracts were determined by the addition of the sugars, starches and pentosans in the N-free extracts and by the subtraction of this sum from the total N-free extracts.

The average digestibility found for the different classes of forage is summarised in Table III:

Forages	Protein		Starch	N-free extract		Pentosan			Total
	non protein	Protein		total residue	soluble residue	Soluble in N-free extract	Insoluble in N-free extract	In crude fibre	
1. Non-leguminous hay and forage.	66.2	37.9	76.2	40.8	43.9	59.7	54.6	56.5	54.2
2. Leguminous hay	85.7	68.1	89.7	61.4	72.3	74.4	34.9	54.1	52.4
3. Concentrated starchy foods . . .	34.9	84.8	97.4	22.9	26.4	100.0	54.8	18.2	68.7
4. Derivatives from cotton seeds, maize bran and rice bran. . .	76.9	66.9	94.4	47.2	50.0	0	81.1	38.6	76.7

VII. — *Digestibility experiments.* — The composition of the different foods are given in Table IV, together with their production value, and the results of digestion experiments made on 2 sheep (data respecting some other feeds being also included).

TABLE IV. — *Percentage of certain feeds digested by sheep and their production value.*

Feeds	Digestibility coefficients					Production value in therms
	Protein	Ether Extract	Crude fibre	N free extract	Ash	
Lucerne *	74.2	44.9	48.3	72.49	49.5	39.2
Lucerne hay	75.3	34.8	46.2	68.8	49.9	39.7
Chopped lucerne hay	73.9	24.5	58.9	73.60	56.4	40.1
Red top sorghum.	56.5	56.4	100	87.4	59.3	76.8
Cotton-seed husks without down . .	0	76.1	46.1	65.0	0	36.3
Cotton-seed husks with down . . .	14.1	68.4	49.0	47.7	25.2	—
Maize bran *	58.2	76.6	59.6	77.2	8.5	70.9
Darso grain	72.5	87.2	80.6	92.2	46.1	—
Darso	64.5	78.1	40.4	88.2	—	87.2
Milo seed (whole).	87.9	88.2	72.3	95.6	73.4	90.0
Ground milo grain	84.0	91.2	2.3	95.9	31.1	90.1
Milo *	55.0	69.0	57.0	82.0	92.0	—
Rolled oats	90.2	95.7	79.0	98.1	41.6	99.3
Selected, whole Swedish oats . . .	77.0	89.0	36.0	81.0	—	70.9
Oat chaff	42.7	57.8	76.1	68.5	13.0	43.1
Oat milling offal	61.5	74.7	30.5	55.8	23.1	30.9
Ground nut shells *	52.8	89.0	12.0	57.6	20.8	11.3
Sesame cake	90.9	61.1	39.5	29.5	19.6	35.5
Wheat.	92.2	91.0	90.1	96.0	79.2	89.2
Wheat bran *	84.3	80.6	43.3	77.4	44.5	54.4
Dark shorts	89.1	83.2	61.4	86.9	44.8	77.8
Rolled wheat.	90.3	86.5	88.1	96.1	82.1	—
Grey shorts	82.6	95.5	0	89.5	28.0	77.3
White shorts	80.0	91.5	33.5	98.9	70.1	92.3

* Average of several experiments.

VIII. — *The marketing of mill feeds* — The author, Investigator in Feed Marketing, Bureau of Agricultural Economics, Office of Rural Economy of the Department of Agriculture of the United States, examines the organisation (from the mills to the purchaser) of the complicated trade of the by-products of milling in the United States, whether this organisation is the work of dealers or of wholesale, or retail, buyers, or of purchasing co-operatives. He treats of the commercial laws regulating this trade, the grades of the various feeds, the method of studying the condition of the market and of ascertaining the quoted prices, the laws governing this trade in the United States and the present needs of the trade.

Purchasing co-operatives, when first started, preferred to buy their goods as soon as they arrived viz. after they had been inspected, rather than from the millers who insisted upon payment on delivery or before the goods had reached their destination. Now, however, that the millers are willing to make good any reasonable claim arising from the quality of the commodities received, they always prefer to buy from the millers direct.

The average difference between the sale price asked by the miller and the retail seller respectively amounts to about 10 dollars per ton, not including carriage, which is not excessive allowing for the expense of storage.

A car-load is 20 tons net. The Official Association of Feed Control in the United States recognises the following classes of feeds, which unless special arrangements are made to the contrary, are generally recognised and accepted by the trade. Wheat bran — standard middlings, — red dog flour, a mixture of low grade flour and fine bran — wheat mixed feed (a mixture of bran and standard middlings in the proportions obtained by ordinary milling) — wheat bran and standard middlings (a mixture of the two latter in the proportions obtained by ordinary milling) — screenings — scourings. F. D.

403. **Breeding Horses, and Sheep in Chili.**

I — NOË, Origen del caballo chileno Causas de su decadencia Resurgimiento. *Boletín de la Sociedad Nacional de Agricultura*, Vol. LIII, No. 10, pp. 657-659 Santiago de Chile, 1922

II. — ENCINA F. A. (Presidente de la Sección de Razas Caballares de Silla, Sociedad Nacional de Agricultura de Chile). Observaciones sobre la formación y el desempeño del Jurado de caballares chilenos *Ibidem*, pp. 659-676 figs. 3

III — PRADO, U Característica de la explotación del ovejuno en Chile, *Ibidem*, pp. 682-688, figs. 6.

I. THE CHILIAN HORSE. — This horse is descended from the Spanish war horses of Arab blood that were imported into Chili in large numbers at the time of the conquest, but the successive introduction of other foreign breeds, for which the best Stud-Stations and breeding conditions were reserved, caused the deterioration of the original Chili horse. About 1880, however, under the auspices of the "Sociedad nacional de Agricultura", the reconstitution of the old valuable breed was commenced, and

its pure-bred, or half-bred, products now form the basis of the Army Remounts Service. The Stock has rapidly improved since 1910, so that Chilian horses are now in favour in countries where horse-breeding has reached a high level.

II. — JUDGING THE CHILIAN HORSE. — The author describes the difficulty of judging Chilian horses entered at Shows, or Competitions, and reminds his readers that an individual examination is only exceptionally made in the above cases owing to the discredit into which it has fallen on account of the bad results obtained from the application of the decimal scale. He points out the necessity for the judges always to bear in mind the standard type of the breed, which he describes in detail: *head* light, of average breadth, with broad, flat forehead, profile rectilinear, or slightly convex; *neck* of medium thickness; *withers* low, but very muscular; *dorso-lumbar line* straight; *croup* wide and full, slightly sloping towards the tail; *chest* broad and deep; *barrel* circumference multiplied by itself and divided by the height of the withers gives about 2.2 viz. a little over the proportion of the Crevat (2.1125), this insures fairly rapid movement combined with speed since the Chilian horse has low withers; *shoulders* straight and muscular (frequent defect, too great development of muscle); *hock* relatively shorter than in other breeds etc.

III. — CHARACTERS OF CHILIAN SHEEP-BREEDING. — Sheep are bred on the long, narrow coast zone which is infertile, or of average fertility. The irrigated zone (central valley), is not suited to sheep rearing, either from its excessive humidity, or because it is more profitable to breed other stock there. The sheep are chiefly grown for mutton, of which the demand exceeds the supply. For this reason, early maturity is the quality most appreciated, and is obtained by crossing the native animals with English black-faced breeds.

In the provinces to the north of Valparaiso, lambs born in June-July are sold to the butcher from September to October, in the South-Central districts, they are sold from October to November, and in the South from December to March; this difference is connected with the growth of the spring vegetation in the various latitudes. In autumn, the market is well supplied with goats and castrated sheep imported from Argentina, while in the winter, the animals offered for sale are imported sheep, or the rejected individuals from the Chilian flocks which have first been castrated, collected and sent to fatten in the central valleys either on the irrigated land that has already been grazed by the cattle, or more frequently, in the vineyards after the vintage. These flocks also include the latest born lambs "marzoles" (those dropped in March).

In the selection of breeds for the improvement of the native sheep, all fat sheep requiring richer pasture than is usually found in Chili must be avoided. The author recommends Southdowns and Suffolks; Hampshire Down and Oxford Down sheep only find suitable conditions in the Central districts; in the southern part of Chili, where there is too much rain for black-faced breeds, Lincoln and Kentish sheep do very well.

Wool is a secondary product of the Chilian sheep-breeding industry; as the animals are shorn twice a year, the conditions are unfavourable

to the Merino which otherwise would have been the best sheep for improving the native stock. It would suit the provinces north of Valparaíso but for the fact that an abundant supply of forage cannot be obtained there throughout the year. This difficulty might, however, be overcome by the rapid spread of "pasto salobre" (1) (*Atriplex semibaccata*) which is thoroughly acclimatised.

The national breed of sheep known as "Lignana", or "oveja de Linares" is distinguished by its long, dense fleece, that is usually self-coloured dark-yellow, golden, roan, white, black, etc. The fleeces of these sheep have always been highly valued, and now realise as much as 50 dollars each.

F. D.

404. Studies in Swine-Feeding.

I — POULAIN, A (Directeur du Centre régional d'élevage porcin des Milles, Bouches-du-Rhône) Centre d'élevage porcin des Milles *Office régional agricole du Midi, Bulletin trimestriel*, No 4, pp 1-25 Marseilles, 1922

II — OTTO Die Kentabilität der Schweinemast *Deutsche landwirtschaftliche Tierzucht*, Year 26, No 52, pp, 553-554 Hanover, 1922.

III — WILLIAMS, D W and MCCONNELL, O E Rice Bran for Fattening Hogs *Texas Agricultural Experiment Station, Bulletin* No 286, 15 pp. College Station, Brazos County, Texas, 1922

IV — MÜLLER and RICHTER Weideversuch mit Lauferschweinen auf Rieselgras und Serradella mit verschiedenen Beifutter *Zeitschrift für Schweinezucht*, Year 29, Part 22, pp 343-345 Neudamm, 1922

V — Ist es zweckmässig, die Ferkel mit sechs Wochen abzusetzen, oder ist ein späterer Termin besser? *Ibidem*, Year 30, Part 2, pp 17-21, 1923

I. — Studies in Swine-Breeding carried out at the *Centre d'élevage porcin des Milles* (Bouches-du-Rhône, France) These include an account of the Marseille breed and feeding experiments.

The Marseilles (2) breed of pig is distinguished by hardiness and fertility and the sows give a full flow of milk. POULAIN hopes by means of systematic selection to be able before long to make it one of the favourite types of swine. Even now, the industrial cross between the Marseilles and Large White provides a very considerable number of animals for fattening.

The feeding experiments conducted in 1920 included *The determination of the heating properties of certain foods*. On the basis of the consistency of the excrement of pigs fed on various foods, the author classifies the latter as follows:

Constipating groundnut cake, sesame cake;

Neutral pulse meal, palm-oil cake, maize flour;

Cooling: bran, barley, sorghum,

Laxative copra, rice-flour;

Irritant or too laxative: raw manioc.

(1) See R. 1922, No. 46, (Ed.)

(2) See R. 1921, 1148 (Ed.)

Feeds have therefore physiological properties that are independent of their composition, so a well-balanced neutral ration can be obtained by mixing them according to their heat causing quality. Taking as his basis the excess or deficiency of faeces as compared with the normal the author obtained the following figures per unit weight of feed: groundnut cake +8; sesame cake +7; legume and maize flour and palm-oil cake +1; bran and barley -1; sorghum -2; copra-cake and rice flour -5; raw manioc -8.

Nursing ration. — The maintenance ration of sows (live weight 100-120 kg.) is bran 1.2 kg. + palm-oil 1.2 kg. + lucerne, cabbages, or pumpkins kg. 2.5. Good results have not always been obtained by using this ration with the addition of 0.6 kg. groundnut cake for nursing sows, but the substitution of 1.7 kg. of bean meal or maize flour for the palm-oil cake has in all cases proved satisfactory and the use of this ration checked diarrhoea among the sucking-pigs.

Feeding piglings at grass. — Young weaned pigs turned out into a field of grass and clover and fed a mixture of equal parts of wheat bran and palm-oil cake weighed 30 kg. after three months, their average daily live-weight increase being 433 gm. per head.

The work done in 1921 included: *Experiments in feeding manioc to pigs.* The manioc was given raw in strips and either soaked or dry, and took the place of cereals in a ration including palm-oil cake and bran. The manioc was incompletely digested and caused severe diarrhoea in the case of the young animals weighing about 50 kg. and also in the piglings suckled by sows fed this ration. The diarrhoeae stopped as soon as cereal flour was substituted for the raw manioc. When ground and cooked, however, manioc caused no intestinal troubles.

Feeding pigs on sorghum. — Summarised in R March, 1922, No. 296

Experiments with different mixtures. — One pig given a mixture of: 1.2 kg. sorghum + 0.3 kg. groundnut cake + 0.45 kg. bran + 0.09 kg. bone meal during the first period (the amount of groundnut cake and of bran being raised during the second period), increased on an average 521 gm. daily in live-weight during the first period and 421 gm. during the second period. Thus, the effect of substituting groundnut cake for part of the bran in the ration of young pigs is to check their increase in live-weight.

Experiments with bone-meal. — Bone-meal when fed to young, growing pigs reduces the cost of meat production, but the animals develop very slowly. The addition of 90 gm. of bone-meal to the daily ration of pigs weighing 35-50 kg. has the effect of producing a further average live-weight weight increase of 1.2 kg. per head and per week and of savings 10 % on the food required to give 1 kg. of meat.

2) *Feeding bone-meal* to sows in farrow caused an increase in the weight of the piglings at birth, their more rapid growth during the suckling period (1 kg. extra weight at weaning) and 16-20 % less decrease in the weight of the nursing sow. These results were obtained by the addition of 100 gm. of bone-meal to a ration of 1 kg. palm-oil cake + 1 kg. bran during the gestation period, and of 1.5 kg. to 1.5 kg. of these feeds

per sow of 100 kg. during the suckling period. Other experiments carried out in 1922 included:

Feeding tests with fish-meal: 1) In the case of growing animals, fish-meal fed at the rate of 200 gm. per 1200 gm. of other food (bran, cereal flour, palm-oil cake) increases the digestive return, that is to say, the proportion of meat produced to food consumed, by about 25 %.

2) By adding 200 gm. of fish-meal to the ration of a sow in farrow fed 1.1 kg. palm-oil cake + 1.1 kg. bran, and 300 gm. to the ration of a nursing sow (1 kg. palm-oil cake + 1 kg. bran + 1 kg. maize) the weight of the piglings at birth was increased by 100 gm. or more, and the loss of weight by the sow during the suckling period fell 30-40 %, while the health of the piglings was better and they put on more weight.

The fish-meal used contained 13 % moisture and fat and 3-4 % of salt and produced no digestive troubles

Experiments with sesame cake. — This cake has long been successfully fed to sheep in Provence and the author found that it could be used with equally good results for sows. Sesame-cake when given in the place of the usual amount of groundnut cake to nursing-sows prevents the sucking-pigs being troubled with diarrhoea, while mixed with fish-meal (bran and maize flour 2 kg. + palm-oil cake 1 kg. sesame cake 0.3 kg. + fish-meal 0.3 kg.) it prevents loss of weight in the sow during suckling and increases the little pigs' rapidity of growth. The constipating character of this cake must however not be forgotten.

II. — THE PROFIT OBTAINED FROM FATTENING SWINE — Dr. OTTO is strongly of opinion that it is necessary in the interests of German Agriculture that pigs should be fattened without using imported foods for the purpose, and to prove that this is possible, he describes three experiments carried out at the "Göttingen Hochschule für Ackerbau" by Prof LEHMANN.

One lot of pigs of improved German breed ("veredelte Landschweine") was fattened for four weeks and during the period the average consumption per head was . fine maize and barley bran 295.4 kg. + fish-meal 26.6 kg. the average increase in live-weight obtained was 84.7 kg. per head Another lot of pigs consumed in four weeks 105 kg. of barley + 42 kg. fish-meal + 802.5 kg. potatoes and increased 88.8 kg. in weight per head. The third lot ate 105 kg. bean bran + 10.5 kg. barley bran, which was fed during the first week only + 844.2 kg. potatoes + grass *ad lib.* and increased 88.2 kg. per head in 5 ½ weeks. The pigs of the third lot took longer to fatten, but as they were not fed imported foods such as maize and fish-meal and therefore cost less, they alone under existing conditions gave any margin of profit.

III. — RICE BRAN FOR FATTENING SWINE. — The work of WILLIAMS and McCONNELL was divided into two series of experiments. 1) to determine the food value of rice bran fed in different proportions with whole flour and meat-meal; 2) to discover the effect produced on the quality of the fat of the carcass by giving rice bran in various proportions mixed with whole maize flour and meat-meal.

Twenty-four Duroc-Jersey pigs divided into 12 lots were used in the

experiment. Six of the lots had first been turned out to feed for about 25 days on groundnuts. The feeding tests lasted 75 days. Each ration was given to 2 lots of which one had been feeding on groundnuts. All the lots had access to a small yard during the experiments.

The results obtained are summarised in the following table.

Lot	Ration feed			Average weight per head		Average daily increase per head	kg food consumed per 100 kg increase in live-weight		
	Maize flour	Rice bran	Meat meal	Initial	Final		Maize flour	Rice bran	Meat meal
	%	%	%	kg.	kg.		kg.	kg.	kg.
1.	90	—	10	71.7	135.3	0.54	401.4	—	44.6
7.	90	—	10	57.9	116.2	0.77	375.3	—	41.7
2.	—	90	10	70.4	114.9	0.58	—	449.1	49.9
8.	—	90	10	57.2	98.5	0.55	—	456.3	50.7
3.	45	45	10	71.7	122.6	0.67	247.0	247.0	55.0
9.	45	45	10	57.2	114.4	0.76	195.3	195.3	43.4
4.	<i>ad. lib.</i>	<i>ad. lib.</i>	<i>ad. lib.</i>	72.2	141.2	0.92	506.0	47.0	6.0
10.	<i>ad. lib.</i>	<i>ad. lib.</i>	<i>ad. lib.</i>	58.1	121.7	0.84	491.0	29.8	9.2
5.	30	60	10	72.6	127.6	0.73	148.5	297.0	49.5
11.	30	60	10	59.5	108.9	0.65	147.6	295.2	49.2
6.	60	30	10	73.5	135.7	0.83	282.6	141.3	47.1
12.	60	30	10	57.2	115.5	0.77	253.3	126.9	42.3

Rice bran added to a ration consisting of meat-meal only (lots 2 to 8) does not yield satisfactory results, for the mixture is unappetising and the increase in live-weight is slower. Fairly satisfactory results can however be obtained by introducing a little maize flour as well as the rice bran.

At the end of the experiment, three animals from each lot were sent to be slaughtered at the United States Experiment Station at Beltsville, the remainder were sent for the same purpose to Messrs SWIFT and Co., Fort Worth, Texas. After 48 hours' refrigeration, the carcasses were classified at both places. Messrs SWIFT classed as "soft": 4 in lot 2; 5 in lot 8; 1 in lot 9; 2 in lot 5; 1 in lot 12 and 1 in lot 6.

At the Beltsville Station, 2 carcasses of lot 8 were described as "a little soft". Thus 50-60 % rice bran may be fed with maize flour and meat meal without inducing softening of the tissues.

Pigs can safely be turned into a groundnut field for some time previous to fattening since this pasturing has no effect upon the firmness of their flesh as was found by an examination of the groundnut grazing and control lots respectively.

IV. — COMPARISON BETWEEN IRRIGATED MEADOW GRASS AND SERRA-DELLA WITH VARIOUS SUPPLEMENTARY RATIONS AS FEEDS FOR FATTENING PIGS (1). — Experiments made by the "Versuchswirtschaft für Schweine-

(1) See R. 1922, No. 1081 and 1347. (Ed.)

haltung-fütterung und zucht." (Pig-breeding Station) at Ruhlsdorf (Tellow). 64 pigs, 4-7 months old, belonging to the common walking breed and of an initial weight of 30-50 kg. were divided into two lots one of which was turned into a field of Italian rye-grass (*Lolium italicum*) and the other into a field of serradella. The rye-grass meadow was irrigated with sewage-water and divided into plots of 30 ares which were grazed successively, the grass never being allowed to grow to a height exceeding 15 cm. Each plot was grazed 6 times a year. The two lots of pigs were each divided into two groups the first of which (No. 1 in the rye grass field and No. 3 on the serradella), received 1 kg per head and per day of a mixture containing 10 kg. maize bran + 1 kg. meat-meal + 0.2 kg. lime while the other (No. 2 on the rye-grass meadow and 4 on the serradella field) were fed 0.25 kg. of the same mixture + 3 kg of potatoes per head and per day

The experiment lasted from September 25 to October 23, 1922. The average daily live-weight increase per head in the 3 groups was respectively 337-388-389-388 gm. The gain on the serradella field was thus the larger, as was to be expected seeing that this plant is leguminous, the proportion being about 5/6, but the increase in live-weight in the group grazing on the irrigated rye-grass was quite satisfactory. The first of the two supplementary rations proved the better, but the difference was not great. Taking 4 kg. of potatoes as equivalent to 1 kg. of the mixture of concentrated foods, described above, the various groups required the following amounts of concentrates to make 1 kg. increase in live-weight: 2.97-3.05-2.59-2.58 kg. or an average of 2.80 kg. Ordinary breeds of pigs as a rule consume 4 kg. of concentrates to produce 1 kg. increase in live-weight. Therefore the consumption of concentrated foods in this experiment was very small which proves the great value of pasturing.

V. — SHOULD PIGLINGS BE WEANED AT 6 MONTHS OR LATER — As a result of experience acquired at the Versuchswirtschaft für Schweinehaltung-fütterung und Zucht at Ruhlsdorf (Teltow, Germany) the author advises that piglings should be suckled up to the tenth week, but that the sow should be served by the boar as soon as she is in heat. It is erroneous to suppose that the milk of a fertilised sow contains substances injurious to sucking-pigs. The sow does not become excessively thin during the nursing period, provided she is liberally and suitably fed. Both seller and buyer benefit from the extension of the suckling period beyond 6 weeks, for the piglings fetch a better price and the increase in live-weight is more rapid. As a rule, the weight of nursing sows decreases considerably until the fourth week, after which it remains about the same to the sixth week, and increases from the seventh to the tenth week till it almost reaches the weight of the sow after farrowing. Piglings are much heavier at 10 weeks than at 6 weeks. Increasing the suckling period decreases the amount of concentrated food required to produce 1 kg. increase in live weight in sow and litter, which in the case of a Yorkshire sow was 2.95 — 2.81 — 2.78 kg. respectively for nursing periods of 6-8-10 weeks.

F. S.

405. Studies on Poultry Feeding.

I. — SCHOFIELD, M. A. Feeding Milk to Poultry. *The National Poultry Journal*, Vol. LXII, Part, 3, No. 116, p. 151. London, 1922.

II. — WOOD, D. Feeding the Heavy Layer, How to Supply the Essentials to Heavy Production *Ibidem*, No. 117, pp. 164-165.

III. — BOSSERT, A. The Rational Feeding of Poultry. *Ibidem*, No. 126, pp. 295-297; No. 127, p. 305.; No. 128, p. 319.

IV. — DOBBIN, R. C. H., Some Lancashire Experiments. Wet versus Dry Mash. *Ibidem*, No. 131, p. 303.

V. — HEPBURN, J. S., HOLDER, R. C., and others. Rations for Feeding Poultry in the Packing-House. *United States Department of Agriculture, Bulletin* No. 1052, 24 p Washington, 1922.

I. — FEEDING MILK TO POULTRY. — The by-products of milk (skim milk, whey butter, or condensed milk or whey, whether liquid, or in powder), have proved most useful in the feeding both of chicks and of adult fowls. Powdered milk must be dissolved before use in ten times its weight of water. Its nutritive value, if equal weights are taken, is the same as that of meat-meal.

Skim milk can be fed either fresh, or sour. It is a mistake to attribute the efficacy of skim milk or whey solely to the lactic acid they contain and to believe that lactic acid can be substituted for the above substances, although a small dose of lactic acid is very good for chicks, as it not only acts as a mild disinfectant of the digestive canal, but is also a stimulant and an excellent remedy against coccidiosis and other diseases. If however, an excessive amount of lactic acid is given, it does serious injury by destroying the mucous membranes; further, it is of no use in the feeding of adult fowls when a well-balanced ration is given. Hence, it is best to reserve lactic acid for a medicine, and to use for food purposes only the by-products of milk.

Skim milk, whey, and a solution of powdered milk are put into the drinking-troughs. The acid solution is made into a mash. Milk powder can also be added to the mash in the proportion of 5 to 10 %. About 5 litres of mash per day is enough for 100 fowls. The whey, or solution of powdered milk, should be fed at the rate of at least 5 litres a head for 100 head. By products of sweet, and of acid, milk ought not to be given at the same time, but may be fed on alternate days.

From the results of his experiments, SCHOFIELD concludes that non-acid milk by-products suit young fowls better than acid ones which ought to be used as a condiment rather than as a food.

II. — FEEDING THE HEAVY-LAYER. — WOOD has studied the application to the feeding of heavy-layers of our modern knowledge respecting the effect of the mineral constituents and the vitamins in the different feeds. As a result of his own experience, he suggests the following ration: equal parts of wheat and oats; mash middlings + bran + gluten + fish-meal + chopped clover, or lucerne-hay + dried yeast + soy-bean meal + ground oats (4:4:4:2:2:1:1). Once in 3 weeks, 2 %

of salt should be added to the mash, and once a fortnight 1 % (by weight) of crude cold-liver oil may be introduced.

III — THE SCIENTIFIC FEEDING OF POULTRY. — A hen that is not laying should be fed, in order for the ration to be well-balanced, for every 100 parts protein 452 parts of carbohydrates and 20 parts of fat. A hen laying 1 — 2 — 3 — 4 — 5 — 6 — 7 eggs weekly, ought to consume respectively, for every 100 parts of protein, 421 — 394 — 375 — 362 — 347 — 336 — 327 parts of carbohydrates, and 26 — 30 — 33 — 36 — 39 — 41 — 43 parts of fat. In calculating the ration of a laying fowl, BOSSERT advises that the egg production should be estimated at 5-6 eggs per week, viz, the ratio should be 100 protein 340 carbohydrates 40 fats, or in the simplest terms, 10 34 4

The following rations fulfil all these conditions per 10 head and per day

1) Middlings 280 gm + meat-meal 80 gm + wheat 370 gm + maize 110 gm + hemp-seed 110 gm + bone-meal 14 gm + green food (grass and roots) 800 gm

2) Middlings 200 gm + fish-meal 100 gm + wheat 400 gm + maize 100 gm + hemp-seed 140 gm + bone-meal 14 gm + green food 800 gm

The grain is given separately, but at the same time as the other substances (which are mixed into a mash) both morning and evening, the green food is given midday

IV — DRY VERSUS WET MASH — This paper gives an account of various experiments described and discussed at a meeting of the Lancashire Utility Poultry Society. Most of the experiments had been carried out on the County Farm, at Hutton, and show that wet mashes should not be discontinued, but given alternately and supplemented by grain fed separately, and by green food.

V — FATTENING RATIONS FOR POULTRY — When, as is the case in the United States, poultry are sent long distances, they should not be fattened by the rearer, as the birds lose their finish on the journey, and the sender cannot dispatch them as frozen meat. Therefore, the poultry rearing industry has to be divided into two branches, the production and fattening branches respectively. Fattening takes 1 to 2 weeks and is carried out at the packing-houses.

Poultry-fattening as a specialised industry is making rapid progress in the United States, this induced the author to carry out his investigations in the Food Research Laboratory of the Department of Agriculture of the United States. He compared different rations and determined 1) the increase in live-weight obtained, 2) the improvement in the edible portions of the fowl

Two kinds of experiment were carried out, in the first, various tests were made for each ration with 12 fowls fed and studied separately.

In the second class, the so-called Battery experiments, a large number of fowls (up to over one thousand in a lot), were studied in flocks. The rations fed the control lot consisted of maize-flour and butter-milk (40 60). In the experiment rations, part of the maize-flour and of the butter-milk

was replaced by one, or more, of the following foods. barley, maize-flour — whole oats — entire oat meal — oat-meal patents — ground oats — rice bran — rice husks — ground rice — wheat offals — wheat middlings — coconut cake — ground decorticated ground-nut cake — undercorticated ground nut cake — colza cake — soy-bean cake — kafir — ground milo — lucerne — meat scraps — condensed whey — powdered whey. The fowls were weighed on the 1st, 4th, 8th, 11th, and 14th days of the experiment

One table gives the composition of the foods used, the other 12 give the results of the experiments

The averages of the most important results are to be found in the following table

Classes of birds	No of birds per class	Increase in 4 days		Increase in 8 days		Increase in 11 days		Increase in 14 days	
Cockerels	612	12	30	23	57	31	78	40	
Pullets	396	—	—	17	60	24	85	2	
Adult cocks	336	11	50	17	77	21	93	22	
Hens	450	1	34	8	65	10	84	12	

The younger birds (cockerels and pullets), increased most rapidly in live weight when given a concentrated protein food such as cake, or meat scraps. The hens did not give uniform results, from which it would appear that meal suits them as well as a concentrated protein food

The best length for the fattening period depends to a great extent upon circumstances. A fortnight is certainly not too long for cockerels, since they continue increasing in weight rapidly for this time, whereas pullets gain all their weight in 11 days. In the case of adult cocks and hens, the fattening period must be limited to 6-8 days

The analyses made of the different parts of the body of a large number of birds belonging to the various classes showed no difference produced by the rations on the composition of the edible portions, or the dressing losses, although the classes differ perceptibly in both these respects.

The yield of edible portions (in % of live weight) was for unfattened and fattened birds respectively cockerels 56 and 60 — pullets 63 and 67 — cocks 62 and 64 — hens 70 and 71, which shows the advantage of fattening. In the last chapter is given the composition of rations for fowls that are to be fattened

F D.

406. Studies in Silkworm Breeding.

I — SECRETAIN, M (Chef de Travaux à la Station Séricicole de l'École Nationale d'Agriculture de Montpellier) Notes séricicoles Essais d'élevage des vers à soie du mûrier avec la feuille de scorsonère Essais d'élevage des vers à soie du mûrier avec la feuille de Maclura Étude sur la grasserie. Bibliography *Annales de l'Ecole Nationale d'Agriculture de Montpellier*, New Series, Vol XVII, Part III, pp 191-216

II — GRANIER (Direction des Services agricoles de Dignes, Basses-Alpes). Essais sur le débitage des vers à soie. *Office régional agricole du Midi. Bulletin trimestriel*, No. 2, pp 48-54, No. 4, pp. 46-53, figs 3 Marseilles, 1922

III — LOMBARDI L. Bozzoli aperti del baco da seta in condizioni anormale di alimerto *Bollettino della R Stazione sperimentale di Gelsicoltura e Bachicoltura di Ascoli Piceno*, Year II, No. 1, pp 12-16, figs 2, Ascoli Piceno, 1923

IV — LOMBARDI, L. Sulla determinazione del sesso nel *Bombyx mori* *Ibidem*, pp 1-7.

V — ACQUA, C. Se il radio eserciti un'azione sullo sviluppo della pebrina. *Ibidem*, pp 8-12

VI — ACQUA, C. L'esame delle ali è sufficiente per la ricerca d'infezione della pebrina? *Ibidem*, pp 39-43

VII — ACQUA, C. Per l'incremento della gelsicoltura e bachicoltura in rapporto anche all'utilizzazione di zone malariche *Ibidem*, pp 17-30

I. — In 1920, SECRETAIN made an experiment in rearing silkworms on the leaves of the viper's grass (*Scorzonera hispanica*) (1) with a view to obtaining if possible 3 broods in one year from an annual breed of silkworms, viz a winter brood on viper's-grass, a normal brood on mulberry leaves and an autumnal one on mulberry leaves. The results were however negative for nearly all the caterpillars died of jaundice, and it appears from a study of the literature dealing with the subject that most of the results obtained by previous investigators were also negative.

Similar results, with a single exception were produced by feeding the larvae on *Maclura*.

These failures cause the author to conclude that one of the causes of jaundice is unsuitable food (2). His numerous enquiries have shown, *inter alia*, that the granules characteristic of the disease vary in shape, being octohedral in silkworms fed on mulberry leaves, and generally trihedral for those reared on the leaves of *Maclura*.

The bibliography at the end of this article contains 50 works.

II. — As a result of investigations in the Centre Régional de Sériciculture of Oraison (Basses-Alpes, France) GRANIER found that the bedding of the silkworms loses through evaporation 29 % of its initial weight the first day; 23 % the second, and 18 % the third; this means a loss of 60 % in three days, which is equivalent to 30 % of the weight of the leaves given to the silkworms. Estimating the moisture content of 1 m³ of air at ordinary temperature to be 5 gm. of water, the ventilation of a silkworm-rearing shed should be so arranged as to allow 67 m³ of air to pass through in 24 hours in order to absorb the moisture given off by each kg. of leaves fed, if the bedding is changed once in 3 days. If the bedding is removed daily, it is possible to reduce by about one-half the volume of air generally considered necessary for the success of silkworm-rearing operations.

(1) See, R. 1921, No. 749 (Ed.)

(2) See R. 1922, No. 1090 (Ed.)

On determining by means of a hygrometer the water-vapour distribution in the incubation rooms, it was found that silkworms lying on irregularly changed litter placed on an impermeable surface were surrounded by a damp atmosphere highly conducive to the outbreak of disease. Hygienically it is better to use a cloth instead of a grating and to renew the bedding daily.

One of the chief difficulties in silkworm rearing in France and other European countries is the dearth and high cost of labour, and the author describes in detail a stand of his own invention with automatically moving gratings by which the work is much lightened. The basic principle of this apparatus is the use of at least two surfaces moving and changing positions independently of each other. One of these surfaces is unperforated and serves as the breeding-tray properly so-called, the other which is composed of a large-meshed network forms a provisional support for the fresh litter and for the caterpillars resting temporarily on the other surface. The unperforated surface consists of an endless cloth, and the grating is made of wire-netting carried by a winding and unwinding drum respectively which are connected so as to render all the operations as rapid as possible and capable of being carried out by the minimum number of workers. The author calculated that the hatching and rearing of 20 ounces of silkworm-eggs would need 440 days' work if the bed were changed every 3 days, 480 if renewed twice in 3 days, and 640 if it every day, as against the 80 days required for renewing the bed daily by means of the new mechanical apparatus.

III. — By feeding silkworms on mulberry leaves sprinkled with a mixture of equal parts of starch and powdered sulphur, LOMBARDO obtained cocoons open at both ends and of a structure recalling that of various wild species, though these are only open at one end.

IV. — LOMBARDO made use of silkworms to test the truth of the theory that the fertilisation of ova as soon as they are mature results in an almost equal number of female and male caterpillars, while the fertilisation of hypermature eggs gives a larger proportion of male caterpillars. He mated a male moth with females that had just emerged from the cocoon or for 1-2 and 3-5 days respectively, obtaining in the 5 cases 49 — 50 — 57 — 61 — 65 % of male silkworms, and 51 — 50 — 43 — 39 and 35 % of females. The theory would thus appear to be confirmed.

V. — Prof. ACQUA stated in reports published in 1914 that radium emanations arrest the development of silkworm-eggs and finally destroy them. In recent experiments undertaken to ascertain whether radium exercises any influence on the development of pebrine, he only obtained negative results, the spores of *Nosema Bombycis* being much more resistant to radium than the eggs of *Bombyx mori*. He also found that radium causes the eggs of silkworms to hatch at unseasonable times.

VI. — Prof. ACQUA states that he was able to detect the pebrine corpuscles quite distinctly in the blood that exuded from half a wing (cut off a living female moth) when compressed between a slide and cover-glass. At least half a wing must be used for unsatisfactory results are always obtained from the examination of only the edge of the wing. This method had

previously been suggested by several other investigators; Dr. FOA of the Istituto Bacologico of Portici (Naples) found it perfectly reliable, and some firms have adopted it with complete success. In one case, the comparative examination or pebrine by the wing method and by means of cell-selection gave wholly concordant results.

VI. — During the silkworm-rearing season, malarial zones, even where no drainage operations have been carried out, are quite healthy for man. Prof. ACQUA suggests that they should be planted with mulberry-trees grown as bushes, or low shrubs for silkworm rearing, the ground being ploughed at the beginning and the mulberries planted at the end of the winter. The returns would certainly pay for the simple plant needed for the purpose.

F. D.

General.

407. Purification of Watering Places and Maintenance of Ponds.

GRAU, A. L'assainissement des abreuvoirs *Revue de Zootechnie. La Revue des Éleveurs* Year 3, No 4, pp 275-277, 1 fig. Paris, 1923.

The author describes the following harmless and inexpensive method of disinfecting contaminated water: dissolve in a bucket of water, a sufficient amount of the following mixture permanganate of potash · 0.025 kg., + sulphate of aluminium · 0.250 kg, + washed kaolin · 0.275 kg.; 1 kg. of this mixture is sufficient for the purification of 5 cub. m. of water. The bucket should be plunged into the liquid and alternately raised and lowered for 3 to 4 minutes so as to obtain as complete a stirring and churning up as possible.

Disease germs and micro-organisms will be killed by the permanganate of potash; the matter in suspension will be collected by the sulphate of aluminium and precipitated by the kaolin. Four days at least are required for clarifying the water. A yellow tinge after treatment indicates the presence of much organic matter but is not dangerous.

A solution of 2 % of permanganate of lime in the proportion of $\frac{1}{4}$ of a litre per cub. m. of water may also be poured into the pond and the water stirred, adding the following day 6 to 7 gm. of powdered charcoal per cub. m. of water

Instead of the permanganate of lime, "Javel" water can be used in the proportion of 1 litre per cub. m., adding after an interval of 4 to 5 days, 100 to 150 gm. of powdered charcoal and 100 gm. of slaked lime per cub. m.

To keep the bottom of the ponds free from leakage after the cleaning process, it is necessary to add to the water, as soon as it has returned, 20 gm. of sulphate of aluminium per cub. m., and two days later 4 gm. of slaked lime; in 8 days time the bottom of the pond will be sufficiently water-tight.

F. S.

408 The Migrations of the Tsetse Fly.

CHORLEY, J. K. (Assistant Entomologist) Tsetse Fly, Eastern Border
The Rhodesia Agricultural Journal, Vol. XIX, No. 1, pp. 680-682 Salisbury, 1922

The author has observed that in Rhodesia the area of the region infested by the tsetse-fly has greatly decreased since 1919, but is of opinion that as soon as the conditions are more favourable, the insects will return to their former haunts. He believes the periodic disappearance of these flies from localities where they were formerly numerous is due to climatic conditions affecting the migrations of big game, and the food supply, and also to the parasitism of other insects. Nothing is known on the latter subject, but the author has succeeded in discovering a definite correlation between the amount of the rainfall and the spread of trypanosomiasis among stock. This may be attributed perhaps to the fact that large game range further in rainy seasons. Other factors, however, besides the movements of the game may affect the seasonal variations in the infested areas. Thus, during the dry period, a district covered with deciduous forest does not afford sufficient shade to attract the tsetse-fly, though it may afford it a good shelter when the trees are in full leaf.

In the district of Wankie, a study is being made to determine the part played by abundance of food and the presence of large game in the variation of the zones infested by this stock pest.

F. S.

409. *Benusomum trigonocephalus*, a Sheep Parasite.

CAMERON, T. W. M., The Sheep Hookworm in Scotland. *The Scottish Journal of Agriculture*, Vol. VI, No. 2, pp. 196-199, figs. 7. Edinburgh, 1922.

Observations made at the Slateford Abattoir (Edinburgh) have shown *B. trigonocephalus*, to be one of the most common parasites of sheep in Scotland where the adult animals are infested by hookworm at all seasons of the year. The lambs are, however, free from this parasite. The author describes *B. trigonocephalus* and the symptoms caused by its presence in a sheep. The life-cycle of this hookworm is not known, but the results of Dr. HESSER's investigations would seem to show that infection takes place from swallowing the encysted larvae at the same time as grass. Before substituting any other stock for the sheep and cattle grazing on infected fields it is necessary to know whether the animals in question are also hosts of *B. trigonocephalus*. The author requests any farmers whose sheep have developed symptoms similar to those induced by this hookworm to forward him a description of the symptoms, together with the intestine of one, or two of the diseased sheep, and to state the duration of the disease and the number of heads attacked. All communications to be addressed to the Department of Helminthology, School of Tropical Medicine, Endsleigh Gardens, London, N. W. 1 (England).

F. S.

410. The Effect of Change of Temperature on the Basal Metabolism of Swine.

CAPSTIK, J. W. and WOOD, T. B. (Animal Nutrition Institute, School of Agriculture, Cambridge). *The Journal of Agricultural Science*, Vol. XII, Part 3, pp 257-266, figs 4 Cambridge, 1922

It is well-known that animals consume a larger amount of food when the external temperature is low, the need of nutrition varying in inverse proportion to the temperature.

There are, however, very few exact data on this subject. The authors have carried out a series of researches with the object of estimating the basal metabolism of swine.

The term, basal metabolism, or resting metabolism, (abbreviation B. M.) is applied to the minimum exchange of materials taking place in the animal organism when the voluntary muscular system is resting and all digestive operations are suspended for the time. This basal metabolism depends upon the activity of all the cells composing the organism and upon the contractions of the myocardium and of the respiratory muscles.

The determination of basal metabolism, which has already become a matter of considerable importance in human physiology and in medical science, is now beginning to be regarded as a necessary factor in stock-breeding, since it affords the sole means of estimating metabolic activity under different conditions.

The data thus obtained are comparable, and make it possible to gauge with accuracy the effect exerted by pathological states and external conditions on the exchange of material and of energy, and thus to arrive at useful conclusions from the diagnostic, pathological therapeutic and hygienic standpoints. Unfortunately, however, the necessary determinations are difficult to carry out.

The total metabolic activity is estimated on the basis of heat production. The most accurate determinations are made by means of the calorimeter, but this entails complicated, costly apparatus that is difficult to handle, especially in the case of large animals, or human subjects, therefore the number of such plants is very few, even in the whole of the United States.

Recourse is therefore had to indirect calorimetry, a much more practicable method, which consists in the determination of the carbon eliminated in respiration and of the soluble nitrogen removed in the urine and faeces, both these waste products being estimated as sugar and protein destroyed by oxidation. The error may amount to 4 %, but it has no influence on the general results.

This process is very lengthy, but it can be simplified by only determining the amount of carbon dioxide given off in respiration. It is calculated that for every litre of carbon dioxide given off 4852 microcalories are developed (the amount being slightly less if protein and carbohydrates are burnt, and rather more if fats are burnt, but the above figure is near enough for general purposes).

The data obtained refer to the time unit (minute, hour, 24 hours).

As a rule, they also refer to the cutaneous area (m^2), for it has been found that under such conditions, metabolism increases regularly with the increase in the cutaneous area independently of the weight

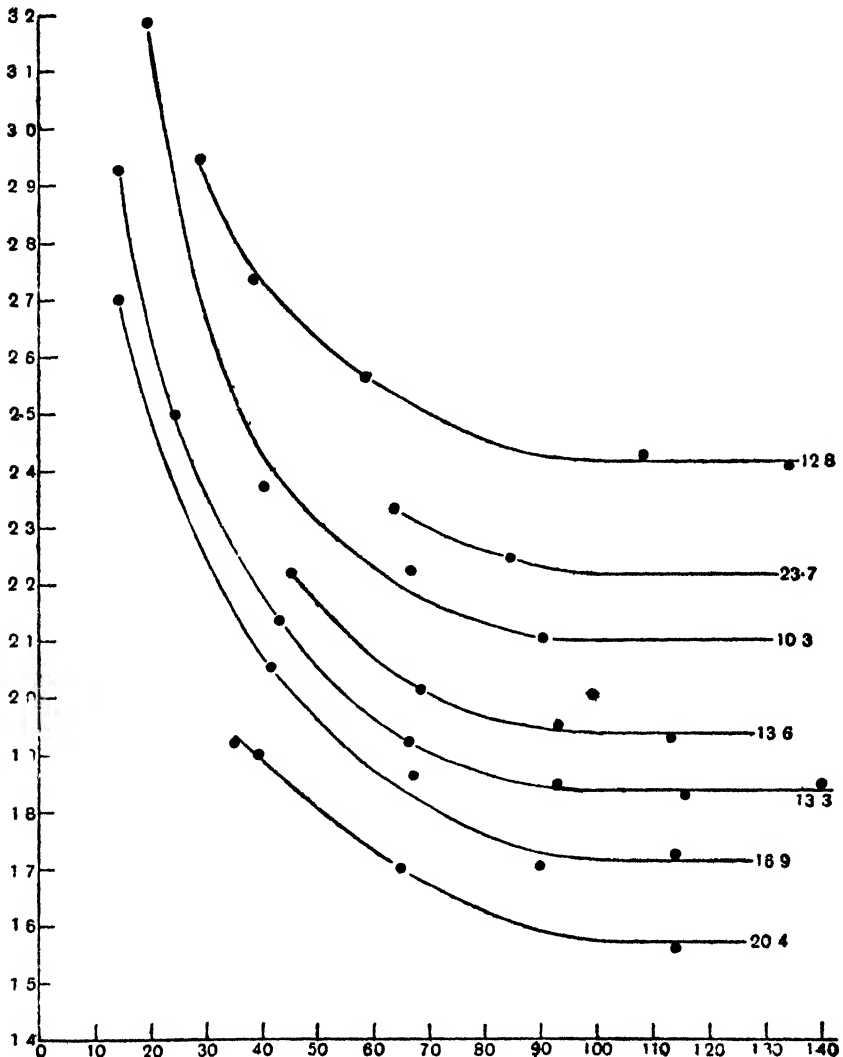


FIG 85 — Abscissae. hours after last meal
Ordinates calories per minute

There are various formulae for calculating the cutaneous area on the basis of certain linear dimensions. Other calculations of basal metabolism are simplified by the use of logarithms or better still, by the help of tables

such as are appended to BOTHBY and SANDFORD'S text-book (Laboratory Manual of the Technique of Basal Metabolic Rate Determination, Philadelphia, published by Saunders).

The authors of the paper analysed employed the direct calorimetric method. They were obliged to confine their investigations to a pig, since although their apparatus was very large, it was inferior in size to the huge calorimeter adopted in the United States which allows determinations to be made upon bigger animals. The pig was 10 months old and weighed 300 lb. at the beginning of the experiment which lasted 140 days (from November to April). By means of a thermo-electric battery and a recording galvanometer the heat given off every two minutes could be registered. These are perhaps the most accurate determinations of the B. M. ever yet made.

In their preliminary experiments, the authors had already ascertained that in the case of a fasting pig, the heat given off slowly decreases

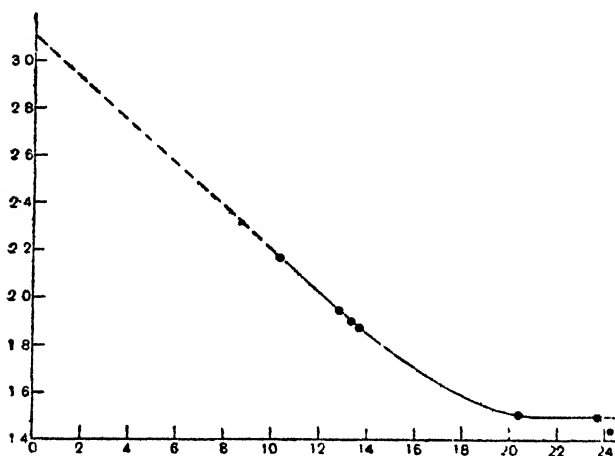


FIG. 86 - Abscissae: External temperature in degrees Celsius.
Ordinates: Calories per minute.

in a fairly uniform manner, any deviations being due to movements made by the animal (in emptying the bladder etc.).

The emission of heat reaches its minimum and becomes stable only after one hundred hours have elapsed, as is shown in Fig 85, in which graphic curves are plotted for each of temperatures given; the curves for the the temperatures ranging from 12° to

23.7° C have however been raised to 0.3 and 0.25 calories in order to make the distribution of the curves more uniform and to show more clearly the rate of heat emission. Some of the graphic curves are incomplete owing to interruptions in the galvanometric circuit.

In TANGLS' experiments on swine, the equilibrium was reached after only 72 hours.

After making the above-described determinations, the authors used to leave the pig in the apparatus for 4-6 days, generally for 5, before estimating the B. M. The pig which was kept in the dark and given water only, and slept many hours continuously.

The pig soon recovered when turned out-of-doors, in fact, in the course of the experiment it increased 157 lb., in spite of having fasted for one-quarter of the time.

As the animal grew older, and therefore increased in weight, it gave off a proportionally less amount of heat, so that the proportion between skin area and weight was reduced. The decrease in basal metabolism in proportion to weight was almost regular. On the basis of the data thus obtained, the authors corrected the determinations made at different times so that they all referred to the weight of 800 lb.

This having been done, it was possible to determine the effect of the external temperature which varied from 10.3° C. to 23.7° C., the extreme temperatures of the place in which the experiment had been carried out. The temperature of minimum metabolism was thus found to be 21° C., this is a critical point, the heat given off being 1.5 calories per minute.

The metabolism remains equally low at about 24° C, the highest temperature tested. On the other hand, by reducing the temperature, the metabolism can be intensified almost regularly 4 % for every of one degree centigrade until the minimum temperature tested, 10.3° C. As is shown by Fig. 86, the deviation observed at 16° C., is probably due to the restlessness of the animal during that special determination and should not be taken into account. From the regular course of the graph, it would presumably be possible to continue it in a straight line above 10.3° C., as is shown by the dotted line in this figure, hence at an external temperature of 0° C, the heat given off would exceed 3 calories per minute viz., it would be more than double the amount emitted at the critical temperature of 21° C.

Practical results : Swine should be kept at a temperature of 21°-24° C., in order to reduce consumption to the minimum and therefore to obtain the maximum utilisation of their food. The greater advantage is obtained the more nearly the temperature approaches the above figures. At 8° C., the average winter temperature of the sty, the consumption is $\frac{1}{3}$ more than at 18° C., the average summer temperature.

The greater consumption is to some extent covered by more liberal feeding, but also partly by the better use of the food given, especially of the coarser kinds which form "extra material" (reserve store).

I., V.

411. The Fat-Protein Ratio in the Feeding of Domestic Animals.

LETARD, E. (Chef des travaux de zootechnie à l'école nationale vétérinaire d'Alfort) Le rôle des graisses dans l'alimentation du bétail Le rapport adipo-protéique. *Revue de zootechnie La Revue des Éleveurs*, Year 2, No. 4, pp. 292-303, tables 2, 1 graph, bibliography Paris, 1923.

The author describes fat formation in the organism and the part played by fats in the ration, and then considers the subject of the fat-protein ratio in the feeding of recently-born animals. This ratio, which has been determined by the study of milk, is as follows: 1-9.82 for lambs; 1-0.85 for calves; 1-0.9 for kids; 1-0.9 for piglings; 1-1.1 for foals; 1-1.2 for puppies; 1-1.5 for donkey foals, 1-1.5 for young rabbits.

Basing his data on the studies of CREVAT and KELLNER, the author gives the following ratios for adult animals, which cannot as yet be pre-

cisely fixed, but may vary within the following limits: work horses 1-2.6 to 1-4; suckling mare 1-4; foal (3-6 months) 1-2; foal (6 to 12 months) 1-3; foal (over 6 months) 1-4; work ox 1-2.6 to 1-4; adult fattening steer 1-4 at first, 1-2.7 to 1.3.1 later; dairy-cows 1-4 to 1-6; dual purpose cattle (2-3 months) 1-1.8 to 1-2; id. (3-6 months) 1-3.1; id. (6 to 12 months) 1-3.8; young work cattle (2 years) 1-4; young heifers (2 years) 1-6; young beef cattle (2 to 6 months) 1-1.7 to 1-2; id. (5 to 12 months) 1-3.2 to 1-3.3; id. (10 to 15 months): 1-3.5; sheep for breeding (of less than 5 months) 1-1.4; id. (5 to 20 months) 1.4-1.6; fattening sheep: 1-2.8 to 1.3-8, nursing or milk ewes: 1-4; pigs (2 to 6 months) 1-2.5 to 1-6.5; id. (6 to 9 months) 1-7.8; id. (9 to 12 months) 1-11.

In practice it is better to introduce the fat into the rations under the form of a natural food rather than as crude or heavy oils which may cause digestive disturbances such as loss of appetite, diarrhoea, etc. In the case of domestic animals, it is well to keep within the following limits: adult horse: 0.800 kg per day and per 1000 kg. of live weight, ox: 0.700 kg. per day and 1000 kg. live weight, sheep: as much as 1 kg per day and per 1000 kg. live weight; swine 0.500 kg to 0.700 kg per day and per 1000 kg. live weight; in the form of milk they can however stand 2 kg of fat per day and per 1000 kg. of live-weight

The author describes how fats can be used in carrying out certain stock-breeding operations. F. S.

412 The Sugars and Albuminoids of Oat Straw.

COLLINS, S H and THOMAS, B (Agricultural Department, Armstrong College, Newcastle-on-Tyne) *The Journal of Agricultural Science*, Vol XII, Part 5, pp. 280-286 Cambridge, 1923

MC CALLUM has proved that although maize grain is a very incomplete stock-feed, adult cattle thrive if fed the whole maize plant, which also promotes the development of suckling calves when it is given to their dams

This agrees with the opinion held that the whole plant of grain cereals has about the same composition as meadow hay. Many agriculturists even maintain that straw makes an excellent stock-feed. The difficulty, however, consists in obtaining straw that animals will eat readily.

The authors studied the chemical composition of straw and the factors influencing its quality. Oat straw was chosen for the experiments as this cereal is much cultivated in Great Britain, and they studied the effect exercised by climatic and meteorological factors and by the application of fertilisers

COLLINS had already previously worked on these subjects, and was enabled to resume his investigations owing to a grant made by the Ministry of Agriculture.

The sugar content of oat straw varies within very wide limits ranging from 6.33 to 9.47 %. The percentage present is much affected by the meteorological conditions during ripening. This sugar disappears by degrees; if the straw is kept dry, its sugar content decreases slowly, otherwise the

percentage falls rapidly. The sugar in oat straw is chiefly levulose, while that of wheat is principally dextrose. In oat straw, levulose never forms less than 50 % of the whole ; the rest of the sugars are derived to a great extent from saccharose one molecule of which consists of levulose.

The protein of straw calculated according to the usual formula, $N \times 6.25$, also has a wide range of variation, extending from 1.12 to 8.05 %. This variation depends to a considerable extent upon the nitrogen content of the soil, the organic nitrogen present being the most important factor.

A useful circle is therefore established, for the nutritious straw supports a large number of stock which, in their turn, liberally manure the soil thus producing a straw rich in protein. The climate also has a great effect, for this reason in the northern districts, where the season is short, the crop is often harvested early, in order that the grain may not have time to abstract the protein from the culms, which therefore remain more nutritious. This explains why Scottish oat-straw is more suited for a cattle-feed than the straw of oats grown in England. Moisture is also an important factor. In dry seasons, the oats are cut early, before the seeds have had time to draw upon the nitrogenous reserves in the culms.

So-called, sweet straw, is in reality rich in protein, not in sugars. The food value of straw seems to depend chiefly upon its protein content

L. V.

413 The Food Value of Dried Whey Solids.

OKA, J. B. and CRICKTON (Rowett Research Institute) *The Scottish Journal of Agriculture*, Vol VI, No. 1, pp 63-67 Edinburgh, 1923.

The authors have tried to estimate the food value of the residues (dried solids and protein) of whey. The residues were prepared in the form of a powder, care being first taken to remove all the fat left after cheese-making, therefore these solids contain 5 times less fat than the residue of ordinary whey.

The object of the first experiment was the comparison of a mixture of dried solids and lact-albumen (protein substances in whey) with whole milk. The experiment lasted 28 days and the pigs used were 34 days old when it began. The results obtained were as follows :

Food	Gain in live-weight	Average ration consumed by each animal
Whole milk	18 7 lb.	61 lb.
Residues	17 8 lb.	Lactalbumen 1 lb. Solids . . . 8 lb.

The ration including the residues contained 8.6 lb. of solids and the other contained 7.8 lb. solids.

In the second experiment, a comparison was made between whey

[413]

powder and whey in its natural condition when they are added to a mash composed of maize, oatmeal and shorts in equal parts.

The results obtained were as follows :

Food	Average amount consumed per animal	Average increase in live-weight
Skim milk and mash	Skim milk . 123.6 lb. Mash 17.8 lb.	17 lb.
Whey powder and mash	Whey powder 11.7 lb. Mash 11.7 lb.	15.4 lb.
Mash	Mash 22.5 lb.	10.8 lb.

The rations of skim-milk and of whey powder contained about the same quantity of solids, and are therefore comparable.

Other experiments have been begun to determine the value of these residues as a calf-feed.

F. S.

414. A Study on the Pasteurization of Colostrum.

RAGSDALE, A. C. & BRODY, S. (Dairy Husbandry Department, University of Missouri). The Colostrum Problem and its Solution. *Journal of Dairy Science*, Vol. VI, No. 2, pp. 137-155, 1 fig., bibliography. Baltimore, 1923.

Colostrum plays a very important part in the regimen of the calf by reason of the globulin and the defensive bodies which it contains, such bodies being absent in the early days of the life of the calves. It is therefore necessary that these bodies and the globulin should be left intact when the colostrum of a tuberculous cow is to be disinfected. Disinfection can be carried out by means of pasteurization by placing the vessel containing the colostrum in a bath and warming by steam heating.

Care must, however, be taken to avoid the coagulation of the colostrum while heating for the purpose of sterilising the tubercle bacilli. The following table shows the time required at different temperatures for obtaining these two results :

Temperature Degrees F°	Time required to inactivate the organism of tuberculosis in milk	Time required to thicken colostrum so that it barely flows
	minutes	
140.0	20.0	3 hours
144.5	18.5	30-40 minutes
149.0	14.0	10-15 "
153.5	7.5	4-5 "
158.0	3.0	2 "
162.5		70-75 seconds
167.0		45-50 "

These figures have an approximate value only and vary with the composition of the colostrum, but they show that colostrum may be safely pasteurized at a temperature of 140° F.

In the experiment, calves that received pasteurized colostrum showed a mortality of 6 per cent. while for those that were fed on raw normal milk the mortality was at the rate of 32 per cent

These figures amply justify the pasteurization of colostrum and show that the process does not materially affect the protein or the protective bodies. Laboratory experiments have also proved that by heating to a temperature of 149° F, the value of the amboceptor or protective body is not diminished.

Further experiments are to be made with regard to the effect of heat on these protective bodies. F. S.

415 Cod-Liver Oil in the Feeding of Cattle and Swine.

I. — DRUMMOND, J. C., COWARD, K. H., GOLDING, J., MACKINTOSH, J. and ZILVA, S. S. Cod-Liver Oil in the Winter Feeding of Milch Cows. *The Journal of Agricultural Science*, Vol. VIII, Part 2, pp. 144-152, bibliography. Cambridge, 1923

II. — DRUMMOND, J. C., ZILVA, S. S. and GOLDING, J., The Use of Cod-Liver Oil in the Feeding of Farm Animals. *Ibid*, pp. 153-162, 1 table, bibliography, Cambridge, 1923

The object of the experiment was to determine whether it is possible to maintain the vitamine content of cow's milk by adding to the ration of the cow small quantities of some substance that is very rich in vitamine A, such as cod-liver oil

Three lots of grazing cows were put into the cow-shed at the beginning of December after the vitamine content of their milk fat had been analysed. From the time they were removed from the field, the animals were given a ration containing no vitamine A, and as soon as the fat had decreased, they were divided into two lots, one of which (lot *a*) was fed pure cod-liver oil in quantities increasing progressively from 75 gm. to 100 gm. per day, while the other (lot *b*) received the same amounts of neutralised olive oil. There was a constant and very remarkable increase in the amount of the vitamine A present in the fat of lot *a*. The vitamin content of the fat of lot *b* also increased, but always remained lower than that of lot *a*. During the whole time the cows were kept in the shed, groups II and III received the same rations as group I, except that from February the cows of group II were allowed to graze for a short time each day, while those of group III could graze *ad lib*. throughout the whole winter. The analysis of the fat content of the milk of these animals showed that the vitamine concentration increased together with the amount of lipochromes in proportion as the grass became richer, but it was always lower than the vitamine concentration in the milk-fat of the animals belonging to the first group.

II. — The cod-liver oil used for feeding farm animals should be clear and bright, it is best when the colour is not deeper than a golden-yellow.

When added in the proportion of 3 drops to 3 cc. + 1 drop concentrated sulphuric acid, it should produce a deep purple colouration. The authors advise that it should be kept in a closed vessel to prevent oxidation by contact with the air. It should be given alone to the stock and not mixed with other substances which would make it difficult to test its quality.

In the case of pigs, from 7 to 18 gm. per day are enough to stimulate the growth and improve the general condition of the animals. In the opinion of the authors, a stronger dose (42 to 56 gm. per day) of first quality oil is very good for sows in farrow and increases both the milk secretion and the vitamins A. It was found by experiment that this oil is readily taken by pigs, especially when they have no access to a pasture and are fed a ration with low vitamin content. Although the meat and fat never acquired any taste or smell of cod-liver oil, the authors advise that its use should be discontinued for some little time before the pigs are slaughtered.

The authors also found that cows readily take 14 to 56 gm. of cod-liver oil daily, and that even if the dose were increased to 112 gm. per day, there was no smell or change of colour in the milk.

F. S.

Breeding

416, **Artificial Fertilisation in Stock Breeding.** (1)

IVANOFF, E. I. (Director of the Central Experiment Service Station for Domestic Animals in Moscow, Russia) *The Journal of Agricultural Science*, Vol. XII, Part 3, pp. 244-256, bibliography Cambridge, 1922.

One of the greatest problems in Russia is the reconstruction of the breeding stock which has been almost entirely destroyed as a result of the war, the revolution and famine.

It is not merely a question of increasing the number of head, but of improving the quality of the animals. Good breeding stock is almost entirely lacking, and whereas before the war, there was one service stallion to every 600 mares, now there is only one to every 3000. A stallion can serve, throughout the year about 10-40 mares, the average being 25-30, hence it is evident that the solution of the problem consists either in greatly increasing the number of stallions, which under the present financial conditions in Russia is impossible, or by using one stallion to fertilise a large number of mares which can be done by means of artificial fertilisation. By this method, the seminal fluid is more economically used; it is distributed in small quantities, but injected in a manner to assist fertilisation. The seminal fluid may be used just as it is ejected, in which case, the sperm-cells are suspended in the secretion of the accessory sexual glands (SPALLANZANI has demonstrated, in Italy the fertilising action of this product), or else, the seminal fluid may be diluted with some artificial solution, such as a solution of sodium chloride, Locke's solution,

(1) See R. 1915, No. 307.

bloodserum, etc. It was at first thought that these artificial media might injure the spermatozoa, but they were found to be unaffected.

Evidently, we here have a case of "artificial insemination" rather than of "artificial fertilisation".

The author gives some data respecting technique. The seminal fluid is collected, by means of a sterilised sponge, immediately after coition. The sponge should be sterilised by immersion for an hour in 60-65 % alcohol and then carefully washed in sterilised water, after which it should be repeatedly washed (and squeezed out every time), in a physiological solution of sodium chloride, or else in a 10 % solution of refined sugar. After it has been ascertained that the spermatozoa are active, they may be injected into the vagina by means of a syringe, or catheter.

It is most probable that, in future, the method will be improved so as to permit of the spermatozoa being kept alive long enough to be sent to a distance. At present, the investigators have succeeded in keeping them alive for a week, but only if the spermatozoa have been taken directly from the epididymus and kept at 10-20° C. When in contact with the fluid from the accessory sexual glands, the spermatozoa acquire the maximum energy, but they die in a few hours.

Artificial fertilisation is of practical importance, not only because it provides the means of fertilising a greater number of females (one stallion sufficing on an average for 300 mares at any season), but from the many other advantages it possesses. Thus, it can overcome female sterility due to mechanical causes (cervical stenosis, flexions, polyps, etc.), allows of crossing individuals differing greatly in size, permits of crosses being made between very distantly related species (zebra with horse or ass, ordinary cattle with bison, etc.), prevents any contagion being conveyed to the male from diseased females (in districts where glanders etc., are prevalent), and is a means of freeing the spermatozoa from trypanosomes (in regions infected with trypanosomosis). Further, this new method makes it possible to ascertain by microscopic investigation the maturation and mobility of the nemasperms, and hence to determine the reproductive capacity of a stallion before, instead of after, his service career has begun; allows of a homogeneous stock being rapidly formed upon which selection can operate with certainty and efficacy, it permits of the possible use of the reproductive capacity of males that are severely wounded, or have died a violent death (in which cases the contents of the seminal vesicles are collected), and renders feasible the fertilisation of wild animals in captivity (deer, foxes which are monogamous, etc.). The chief advantage of this method, however, certainly consists in the opportunity it affords of rejecting inferior males and using the best individuals to the fullest extent.

The author gives a short account of the work carried out in Russia on artificial fertilisation as applied to the breeding of stock, especially of horses. The preparatory, or experimental, stage was followed by many practical tests, and finally a special Laboratory and a Station were instituted at Askania-Nova. By these means it was possible to determine the conditions of success, one of the most important of which is the repetition of the trials. The number of fertilisations proved to be, on an average

ten times as large as under natural conditions, as many as 78 % of positive results being obtained which is more than those produced by natural fertilisation, further, it was found that the offspring were not inferior in vigour and reproductive capacity to the young of naturally mated animals. Practical courses were then started; these were attended by 400 persons between 1909 and 1919; lectures were also given so that the method became widely adopted in Russia and the first test on a large scale of the artificial fertilisation of domestic animals was thus carried out.

The results of a questionnaire sent out by the author and of enquiries he made showed that, before to the war, artificial fertilisation was practised in, at least, 30 Governments and was spreading rapidly, so that in 1912, the author was able to obtain reliable data respecting 3397 cases of artificial fertilisation from 41 Service Stations in European Russia; the proportion of positive results was 41.4 %, but if only stallions in heat were taken into account, the percentage rose to 59. In one Station, 90.7 % successes were scored, while at Askania-Nova 100 % positive results were obtained from 2 stallions.

Unfortunately, the War and the subsequent vicissitudes disorganised this work as well as other forms of research, but an effort is now being made for its reconstruction. In 1919, at one of the Pan-Russian Stock-Breeding Conferences, inaugurated by the Live Stock Department and the People's Agricultural Commissariat, and in successive Pan-Russian Conferences for horse-breeding, the problem of artificial fertilisation was considered of immediate importance. The College of the Commissariat decided to start a Central Experiment Station for the study of the breeding of domestic animals, one of the chief objects of this Station being the practical organisation of artificial fertilisation. In 1921, many requests reached the Station, but unfortunately nothing could be done owing to the complete lack of material and workers, but in 1923, a number of experts were to take diplomas and proceed to institute Service Stations provided with the means of artificial fertilisation, in various parts of Russia.

The work of artificial fertilisation has often been entrusted to persons, who not being experts, made serious mistakes, such as injecting semina into already fertilised mares (which produced abortion), or using sterile stallions, or stallions not in heat, etc. Sometimes again, the task was imposed upon veterinarians, who receiving no pay for their work, carried it out once a week as a kind of forced labour, taking no responsibility as to results.

The author urges the use of capital for this work of reconstruction, and points out the commercial advantages to be derived from it, giving as an instance the following calculation made in gold roubles: equipment of Station for artificial fertilisation 200; two stallions 1000; maintenance expenses for four months 200; wages 200; stabling 100, total 1700; returns from artificial fertilisation of mares at 5 roubles each, 3000; profits 1300 (representing 76 % on the capital outlay).

L. V.

417 Genetics in Fur Farming.

MCARTHUR, J. W. O. A. C. *Review*, Vol. XXXV, No. 7, pp. 267-268 and p. 10 Guelph (Canada), 1923

On crossing a pure silver fox with a red fox, hybrids of intermediate colour ("patch") are obtained in the F_1 , while the F_2 consists of $\frac{1}{4}$ pure red, $\frac{2}{4}$ patch and $\frac{1}{4}$ pure silver individuals. The pure silver animals when mated together, produce pure silver offspring, and if crossed with patch individuals, they produce 50 % patch animals and 50 % pure silver hybrids. The silver character is, however, composed of several variants all of which make their appearance pure, without any admixture. Pale silver is partially recessive to dark silver.

A series of colour mutations have been observed in the skunk viz., black, seal brown, striped, almost pure white and pure albino. These colours are transmissible and can be obtained pure, if care is taken to avoid too close-inbreeding. In the skunk, as in the fox, the hybrids of these mutations transmit their characters according to the law of segregation. As a rule, colour is dominant to albinism, and whole black to white stripes, but in the F_2 , the parental types may appear either pure, or in the form of some new combination.

F. D

Special.

418 Stock Raising and Beef Production in the Philippines.

BUENCAMINO, V. Our Meat Supply, *The Philippine Agriculture Review*, Vol. XV, No. 3, pp. 237-240 Manila, 1922

The author uses the special experience gained in the city of Manila and the neighbouring provinces as the basis of information which may be a useful guide to traders in live-stock in the Philippines and describes at the same time the different breeds that are raised and their characteristics.

The Manila market is supplied with native cattle from Batangas, Dalupiri, Fuga and the islands to the south of Luzon and with foreign cattle coming from China (Hong-Kong, Tsingtao), from Cambodia (Pnom Penh), from Annam (Qui-Nhon), from Australia (Wyndham).

The most profitable breed of native cattle, which resembles very closely that imported from China, is the Batangas. This is the only Philippine breed which is docile and can also be used for work. It arrives in good condition being usually at least 5 years old and averages about 126 kg. dressed weight.

The Dalupiri cattle are descendants from a Spanish breed but during the last 10 years, Indian blood has been introduced. The average weight is about 90 kg. and the flesh has a dark tinge. It is a wild race and generally killed at the age of 3 years without previous fattening; the same may be said also of all the other Philippine breeds with the exception of the Batangas.

Fuga cattle are very small averaging at most 60 kg. dressed weight. The stock seems to be degenerate and to have insufficient pasture.

As regards the islands to the south of Luzon, Masbate stands first both for number and quality which is probably due to its fine pasturage. The type is beginning to show evident traces of the infusion of Indian blood. The average weight is 80 kg and there is a little yellow fat.

Mindoro and Marinduque cattle have an average weight of about 66 kg, they are fat but somewhat less wild than the Dalupiri.

The Mindanao type is distinctly Indian and it appears that this island is likely in the near future to become an important centre of beef supply.

Selection, castration, improvement of pasturage and fattening would bring about a great improvement in beef production in the Philippines.

At the present time, the best beef cattle are imported and their dressed weight averages 150 kg at the age of 6 years. They are very fat, docile and good workers, with the exception of those imported from Australia.

Hongkong cattle are short-legged, bulky, fleshy and small-boned, their dressed weight is from 45-55 per cent. The hide is thick and suitable for boot-soleing.

The Tsingtao cattle are still larger and are about the same size as the Australian, with an average of 200 kg dressed weight or over.

The Pnom Penh cattle are large-boned, very hardy, thrive well on rice straw and are resistant to the risks of transport. They are in special favour for the manufacture of anti-rinderpest serum and are good workers.

Annam supplies a limited number of small docile animals, with an average dressed weight of about 100 kg.

The cattle imported from Australia are large and fat with an average dressed weight of from 260-270 kg. and a maximum of 300 kg. They give 50-60 per cent of beef and are readily accepted on the market but transport is difficult and risky as they are very wild and non-resistant to disease.

F. D

419 **The Necessity for Calcium and Phosphorus in the Diet of Dairy Cows.**

122 MEIGS, E. B. (Dairy Division, United States Department of Agriculture). *The Mineral Requirements of Dairy Cows, Present Status of the Question* *Journal of Dairy Science*, Vol VI, No 1, pp 46-53 Bibliography, Baltimore, 1923

The author after reference to the work of FORBES and HART, sums up the evidence so far presented by stating that it appears that liberally milking cows are usually able to maintain themselves in calcium and phosphorus equilibrium (1), when they receive an abundance of good lucerne hay, combined with concentrated foods, rich in phosphorus.

(1) See R. 1922. No. 842. (N. d. R.)

The Ministry of Agriculture of the U. S. A. is at present making an experimental test to establish the value of coarse foods with a low calcium content which are fed instead of lucerne. To one group of cows is given a mixture of grains high in protein and timothy hay only, or timothy hay and silaged maize; another group received the same rations with calcium carbonate added, or a ration containing the same or approximately the same protein content but with lucerne hay, instead of timothy. These experiments have not yet been completed, but the results obtained, show that sooner or later the yield of milk from cows who receive forage with a low calcium content, is greatly diminished and that this decrease is mostly due to the calcium deficiency.

On the other hand it appears that the liberally milking stall-fed cows can be kept in calcium equilibrium only if fed on large quantities of forage with a high calcium content as for example, lucerne hay.

Since the experiments of FINGERLING and HART, many others have been made, and seem to indicate that the assimilation of calcium and phosphorus is influenced by vitamins. Dairy cows on pasture can maintain calcium equilibrium on a smaller absolute calcium intake than those on dried materials with or without maize silage.

FORBES reported that in the case of cows that were dry or giving only small amounts of milk, the calcium and phosphorus balances were both usually positive. The cows used in these experiments, however received lucerne hay.

Some tests were made by the Ministry of Agriculture of the U. S. A. to determine what influence the substitution of timothy hay for lucerne had on cows giving small amounts of milk. Cows on timothy hay have continued to give a small amount of milk for many months consecutively, but these cows were being fed on rations which contained much more protein and nutritive matter than they required according to any of the feeding standards.

It is likely therefore, that the results indicated only confirm the theory that cows giving small amounts of milk can eat much more food than they require, and compensate in that way for the absence of a particular substance in the rations given to them.

It is perhaps not too strong a statement that it is always bad practice not to include liberal quantities of leguminous hay in the rations of dairy cows which are receiving only dry feeds and silage.

The dairy farmer must not expect to obtain a large yield of milk in winter if he cannot give his cows lucerne and other leguminous hay in large quantities. It will probably pay him also to see that each of his cows has a dry period of two months and that during this period she receives twice the maintenance ration in protein and total nutrients.

The author also states that so far experimental work has not been sufficiently advanced to demonstrate whether lucerne hay can be replaced by other leguminous hays to provide a source of calcium, or how the calcium requirements of cows on different kinds of pastures can be supplied.

F. S.

420. A Study of the Influence of the Genetic Factor and Environment on Milk Yield.

SANDERS, H. G. (School of Agriculture, Cambridge). The shape of the lactation curve. *The Journal of Agricultural Science*, Vol. XIII, Second Part, pp. 169-179, tables 7, figs. 2, bibliography. Cambridge, 1923.

Taking as a basis the figures supplied by the Penrith (Cumberland and Westmorland) Milk Recording Society, the author has constructed what he calls a "Shape-figure" for each lactation period and from an examination of such variations in this figure as are due to the chief factors affecting milk yield, he has arrived at certain conclusions regarding the influence of environment and of the genetic factor.

The "Shape figure" (S. F.) is obtained by dividing the ratio existing between the total yield of the lactation period and the daily maximum production during the period, by the average ratio between the two values for cows calving during the same month as the cow whose lactation period is under observation. These average ratios for the different calving months are as follows: January: 178.6; February: 166.2; March: 165.4; April: 154.0; May: 142.9; June: 145.1; July: 151.6; August: 185.6; September: 183.4; October: 190.5; November: 198.0; December: 183.7. The S. F. thus serves to correct the calving month. On the basis of 100 days' interval between calving and the next fertilisation, the author obtained the following corrections to be made in the S. F. for different intervals between these dates: 0-19 days + 22%; 20-39 days + 16%; 40-59 days + 9%; 60-79 days + 5%; 80-99 days + 1%; 100-119 days - 3%; 120-139 days - 7%; 140-159 days - 10%; 160-179 days - 13%; 180-199 days - 15%; 200-219 days - 17%; 220-239 days - 20%; 240-259 days - 22%; 260-279 days - 24%; 280-299 days - 26%; 300-319 days - 27%; 320-339 days - 28%; 340-359 days - 29%; 360-379 days - 30%; 380-399 days - 31%; 400-419 days - 32%; 420-439 days - 33%; 440-459 days - 34%; 460-479 days - 35%; 480-499 days: 35%.

On examining the effect of age on the S. F., the author found that, in the case of the first lactation, this figure was generally 11% higher than in that of the second lactation. It varies little between the second and the fifth lactation, and the reduced yield after maturity is not due to any physiological deterioration of the glands, but to feeding and other factors. The author has not been able to reach any definite conclusion as regards the rest period preceding lactation.

In order to determine whether the milk yield of a cow depends solely upon the environment or also upon hereditary capacity, the author compared the standard deviation of all the 355 S. F. of a group of 100 cows with that of the S. F. of each of these animals and found that the latter deviation was less. On the other hand, the standard deviation of the average S. F. of any group of 3 lactation periods taken from the 180 lactation periods of the 60 cows under consideration when compared with the standard deviation of the average S. F. during the 3 lactations of these 60 cows shows that the latter deviation is the greater. These compari-

sons were made with uncorrected S. F. which were subsequently corrected for the effect of calving and the following fertilisation. They show that the S. F.'s of different cows have a tendency to group themselves around a type which would seem to indicate a genetic influence for each cow. Further, on comparing the S. F.s of good milkers with those of cows of inferior yield, the author found that the first, the ratio between the maximum daily yield and the total production was higher for the second class, this difference being very marked in cows of the same herd

The variations in the ratio between the total yield and the maximum daily yield of the same animal, leaving out of account variations due to accidental circumstances, throw some doubt upon the value of the maximum daily yield as a basis for determining the hereditary capacity of a cow.

F S

421 Influence on Cows' Milk Secretion due to the Change from Dry to Green Diet.

GOLDONI, E. Modificazione della secrezione lattea nel momento di transizione del regime secco al verde *La Nuova Veterinaria*, Year I, No 3, pp 8-9, No 4, pp 101-105, table I, Bologna, 1923

The author has made an experimental study of the alterations in milk secretion and on the composition of milk in cows when sent to pasture after being fed on hay. The conclusions are as follows: grass feeding appears to favour an increased yield, especially at the evening milking, but it does not seem to affect the yield in proportion to the age of the cow, or the condition of the secretion. When on grass diet, the evening milking tends to be more abundant than the morning milking, the acidity of the milk of cows whose lactation period is already advanced increases whereas it diminishes with other cows and the point of congelation is slightly lowered, moreover, the density of the whey may diminish and its congelation point decrease. Grass feeding has no effect on the content in fatty matter and the examination of the average yields of all the cows shewed that for both dry and grass diet, the degree of acidity, the amount of dry and non-fatty residue, the density and the percentage of water were the same, although during the change of diet, the density had slightly increased for the morning milk and slightly decreased for the evening milk. On the whole, the variations between the figures for these different points, were less marked for a grass than for a dry diet.

F S

422 Study of the Variation in the Milk Yield of Guernsey Cows.

GOWEN, J. W. (Maine Experiment Station). Studies in Milk Secretion. Relation Between the Milk Yield of One Lactation and the Milk Yield of a Subsequent Lactation in Guernsey Advanced Registry Cattle. *Journal of Dairy Science*, Vol VI, No. 2, pp 102-121, tables 21, bibliography Baltimore, 1923

From the data supplied by 1476 lactation periods of Guernsey cows belonging to the American Guernsey Cattle Club Advanced Register,

the average differences between the milk yield of cows of a given age that had been previously tested for milk production, and the yield of other cows of the same age of which the milk production had not been controlled previously, were as follows: 590 kg. for cows of 3 and 6 years of age, 545 kg. for those 4 years old, 680 kg. for cows of 5 years of age and 900 kg. for those of 7-8 and 9 years of age. These differences would seem to be due mainly to external factors (maintenance, feeding, preparation) which can cause a variation of $\frac{1}{8}$ to $\frac{1}{6}$ in the milk yield.

On the other hand, a somewhat close connection exists between the milk yield of one lactation period and that of another; this correlation may be expressed by the coefficient 0.696 in the case of Guernsey cows.

Table I gives the equations for calculating (upon the basis of the milk production at a given age) the milk yield of the same Guernsey cow at another age. In this table, Y represents the required yield at the age expressed in the form of the coefficient and y the yield at the age (also expressed by the coefficient) on which the calculation is based. These figures refer to lb

$$Y^3 = 1803 + 1.003 y^2$$

$$Y^4 = 3686 + 0.842 y^2$$

$$Y^5 = 4458 + 0.940 y^2$$

$$Y^6 = 3347 + 0.984 y^2$$

$$Y^{7,8,9} = 5669 + 0.779 y^2$$

$$Y^4 = 2713 + 0.895 y^3$$

$$Y^5 = 5610 + 0.658 y^3$$

$$Y^6 = 4190 + 0.837 y^3$$

$$Y^{7,8,9} = 6016 + 0.677 y^3$$

$$Y^5 = 1099 + 1.075 y^4$$

$$Y^6 = 3685 + 0.801 y^4$$

$$Y^{7,8,9} = 2613 + 1.055 y^4$$

$$Y^6 = 570 + 1.062 y^5$$

$$Y^{7,8,9} = 4742 + 0.728 y^5$$

$$Y^{7,8,9} = 1172 + 1.069 y^6$$

$$Y^{7,8,9} = 3492 + 0.829 y^7$$

F S

423 The Variation in Milk Yield and in Transmission of Milk Characters in Jersey and Red Danish Cattle.

TAGE, ELLINGER (Bussey Institution, Harvard University) The Variation and Inheritance of Milk Characters *Proceedings of the National Academy of Sciences of the United States of America*, Vol 9, No 4, pp 111-116, tables 7. Easton, 1923

The correlation between the lactation period and the rest period is 0 for the Danish breed and 0.25 for Jerseys. The duration of lactation is not affected by the maximum yield of milk during that period and is influenced very little by the rapidity of the fall in the milk production, but on the other hand, 80 to 90 % of the variation in yield is due on an average to the calving time.

After comparing the variation coefficients of the first 4 periods of 10 weeks of the first lactation period, the author reached the conclusion that under existing conditions, the yield during the first 10 weeks of lactation gives the best basis for estimating the milk production of a cow.

In the Red Danish breed, there is no correlation between the amount of milk given and the fat content of the milk, whereas in Jersey, the coefficient is 0.33

In the case of the Red Danish cows, 75 % of the variations in the total fat yield are due to variations in the amount of milk produced, and only 25 % to differences in the fat content. From this standpoint, the influence of the season is very considerable; a difference of 15 % having been observed between the yield of cows calving in October-December as compared with that of cows not calving till January-March.

The author is of opinion that milk characters are transmitted in the same manner as "blended" characters (1). He was unable to find any factor that followed the Mendelian laws. F. S.

424 Milk as the Sole Ration for Calves.

MC CANDLISH, A. C (Dairy Husbandry Section, Town State College of Agriculture and Mechanic Arts). Studies in the Growth and Nutrition of Dairy Calves. *Journal of Dairy Science*, Vol. VI, No. 1, pp 54-66, tables 9, bibliography Baltimore, 1923.

The author first summarises the work previously done on the subject, and then describes his experiment and the conclusions he reached from the study of the results obtained. Two calves were used in the experiment, which throughout their lives (208 and 176 days respectively), were given only milk and licking-salt. The amount of milk and salt consumed, the weight and body measurements (which were taken every 30 days), as well as the increase in weight and height as compared with that of a normally-fed calf are given in the tables. Other facts are also noted including the results of the post-mortem examination of the two animals.

(Comparison between the food substances required by calves and the food substances supplied.)

Age	Average live weight	Amount of milk received	Food substances given			Food substances required		
			Dry matter	Digestible		Dry matter	Digestible	
Days	Kg	Kg	Kg	Crude protein	Total	Kg.	Crude protein	Total
				Rg	Kg.		Kg.	Rg.
1-30 . . .	76	260	35	8.55	47	52	8.58	49
31-60 . . .	96	300	41	9.90	54	67	9.45	50
61-90 . . .	122	379	52	12.60	68	88	13.50	67
91-120 . . .	139	405	55	13.50	72	100	12.15	76
121-150 . .	143	393	54	13.05	75	103	12.60	78

From these data, the author concludes that although milk as a sole ration gives good results during the first three months of the calf's life, it is not sufficient for the animal at a more advanced age. On comparing the food elements given to the calves used in the experiment with those

(1) By "blended" factors are understood those producing in the F_1 a type different from that of either parent and appearing in the F_1 as if they were homozygous. (Ed.)

which ought to have been supplied to them, it is seen according to the figures of WOLFF-LÄHMANN (see appended table), that too little dry matter was given from the beginning of the feeding-experiment, the deficit being 33 % for the first 30 days, and rising to 66 % by the 150th day. The amount of digestible, crude protein and of nutritive substances was sufficient during the first 30 days, after which it was deficient though not in the same degree as the dry matter.

The lack of sufficient dry matter and the absence of roughage did not allow the digestive system to develop normally so as to be able to deal with all the digestible nutritive matter ingested by the animal, so that a certain amount which had not been acted upon by the digestive juices remained in the alimentary canal and decomposed there.

On reaching the weight of 67 kg., the two calves sometimes consumed as much salt as an animal weighing 450 kg., and as a rule, they ate 6 times more than a calf of the same weight fed in the normal manner. This may have been one of the causes of the digestive disturbances noted in the calves used in the experiment.

Possibly there were not sufficient antineuretic and antiscorbutic vitamins present and this may have been the reason of the unsatisfactory condition and the death of the calves

F. S.

425 The Water Buffalo for Dairy Purposes.

LEVINE, C O (Professor of Animal Husbandry) *The Lingnaam Agricultural Review*, Vol I, No 1, pp 1-30 figs 6 tables 29, graphic curves 2 bibliography Canton, 1922

The author describes the water-buffalo of S China (*Bubalus bubalis* Lyd.) and gives an account of its origin and distribution, together with the results of observations made at the Canton Christian College in order to ascertain its value for dairy purposes. The observations were made during the last 4 ½ years, and the data on which the author depends refer only to lactation periods during the whole of which the milk production was tested. The fat analysis were made twice a month, the morning and evening milk being examined separately, and the milk yield was controlled twice a month at first, and during the last 3 years, at every milking

For the greater part of the observation period the cow-buffaloes were given for each kg. of milk produced daily 4 kg. of a mixture consisting of 7 parts rice bran, 4 parts wheat bran, 3 parts rice sweepings and 2 parts crushed groundnut-cake. In addition, each of them received daily about 40 gm of salt, enough water to make their ration into a stiff paste, and 27 to 45 kg of a mixture of finely chopped grass. The average weight of the female buffaloes was 485 kg. and their average milk and butter production per lactation period was 870 kg. and 96 kg. respectively. The mean fat content was 11.05 %. The following are the averages of various analyses of samples of morning and evening milkings: fat 12.46 %, mineral substances 0.89 %, protein 6.03 %, sugars 3.74 %, water 76.89 %. At first, just after calving, the milk yield varies from 2.25 kg. to 6.75 kg. but this quantity gradually decreases during the lactation period which

lasts from 8 to 11 months. In most cases, the fat content continues to increase; it begins the first month at 8 to 10 % and reaches 15 or 17 % by the last month. The milk and butter are both pure white. The butter has an excellent flavour and is preferred both by Europeans and natives to cows milk butter.

Since these experiments were conducted with ordinary unimproved buffaloes of the dairy and work-type, and the common buffalo now produces 4.50 kg. of milk daily for several months and its annual output is at least 1125 kg. of milk and 67-146 kg. of butter, the author is of opinion that animals of high yield could be obtained in a few generations by means of skilful selection and careful breeding. The present type of buffalo is very resistant to piroplasmosis and tuberculosis. The disease to which it appears most subject is rinderpest, but fortunately the Bureau of Agriculture of the Philippine Islands has discovered a vaccin that immunises the buffalo for at least two years. The author mentions that the average weight at birth of 10 bull-calves and of 8 cow-calves was 31 and 30 kg, the average gestation periods being 347 days and 338 days respectively.

F. S.

426 **The Use of Graphic Charts in Calculating Sheep Rations by the Method of Forage Equivalents.**

LEROY, A M (Chef de travaux à l'Institut National Agronomique) Alimentation du Bétail par la méthode des équivalents fourragers Emploi d'un procédé graphique pour le calcul du rationnement des moutons pendant leur période de croissance *Revue de Zootechnie, La Revue des Éleveurs*, Year II, No 2, pp 103-116, graphic charts 4, figs 3, bibliography Paris, 1923

The author considers that a sheep's ration is composed of a maintenance ration strictly proportionate to the animal's live-weight, and the production ration which is in relation with the daily increase in live-weight, or with the amount of the milk yield

In one graphic chart, he gives the variations in the number of food units that the maintenance ration should contain in function of the live-weight. By means of another graph, he expresses the variation in the production ration in order to obtain a determined increase in live-weight, in function of the age of the animal, and at the same time, the law of variations in sheep at the expense of growth, or fattening. By reducing these graphic curves to straight lines, the author has succeeded in combining them in a single graph (here reproduced), which allows him to determine directly the forage value of the daily ration to be fed a lamb of given weight and increasing its live-weight daily by 100-250 gm. (See Fig. 87.)

The data used for the construction of these diagrams were obtained from experiments conducted by the author at the National Stock-Breeding Centre (*Centre National Zootechnique*) of Vaulx-de-Cernay, near Paris.

The author gives several instances illustrating the use of these graphic charts.

Value of total ration of sheep, expressed in forage units determined in function of the live-weight and daily increase in weight.

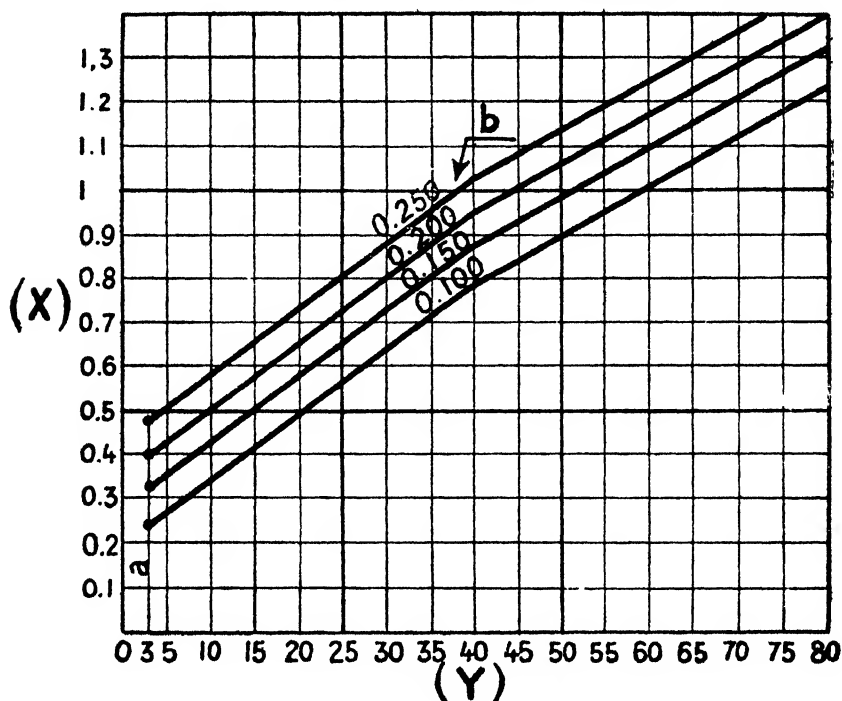


FIG. 87. — Estimation of the ration expressed in units of forage as a function of the weight age daily increase

a Total maintenance ration as forage units.

y Live weight in kilos.

a Weight at birth.

b Daily increase in live weight, per head

F. S.

427. The Selection of Rams for Studs and Flocks in South Africa.

VAN HEERDEN, W S (Sheep and Wool Expert, Division of Sheep and Wool). *Journal of the Department of Agriculture*, Vol. VI, No. 2, pp. 151-152, figs. 6. Pretoria, 1923.

The author describes the conformation of a good ram, draws attention to the importance of its having no wool on the face, and considers the choice of type and breed.

In the first place, the animal must have a good constitution and if the choice lies between good constitution and fine wool it is better to choose the first and begin with inferior wool. The ram must be of pure-bred, recognised stock and should belong to a line of which the prepotency was

first obtained by inbreeding and then fixed by breeding from lines carefully selected within the same families. Such animals will be far more likely to sire offspring similar to themselves than those which are the result of a cross between two breeds. The author classifies the sheep of South Africa as follows.

Breeds	Merino types	Merino sub-types	Merino lines
Merinoes	Rambouillet	Bundemar	Sir Charles
	Tasmanian	Wanganella	Magician
		Grossdale	Emperor
		Ferfurplants	Marmion
		Hillmoor	Donald Dinnie
		Highland Home	
	Vermont	Bellevue	
		Winton	
English Long wool breed	Lincoln	These types are of little importance in South Africa.	
English Short wool breed	Suffolk		

In his opinion crossing the different breeds offers no advantage as regards wool production and crossing the various types is open to much objection, for rams obtained by a cross between different types do not possess as much prepotency as those belonging to a line that has been inbred for many years. Farmers should therefore try to procure rams belonging to a pure type, or sub-type. The author advises that no animal resulting from a cross between a type and a subtype should be used for the production of stud stock until the new type has become fixed and its dominance secured by in-breeding. On the other hand, there is no object in crossing two subtypes together, since each of them can produce offspring of good quality and the use of an animal descended from two parents of selected stock which are not exactly alike, as they belong to two different subtypes, introduces a certain amount of irregularity into the breeding-stock.

In the case of Merino wool, all extremes are bad, but if there is to be a leaning to one side or the other, length should be preferred to density. A good long combing-wool is always appreciated, and the constitution of the sheep suffers less in the production of a long wool than in growing dense heavy wool.

The ideal wool is moderately thick and of a good length, and possessing all the qualities required for combing. In order to obtain it, the sheep-breeder must take the climatic conditions into account, for these may modify the length of the product. In bad seasons, very fine, or moderately fine wools should be short, and leave much waste, whereas a strong wool will grow to a fair length. On the Grassveld, and especially in the coldest parts, the wool, quite independently of the season, usually becomes finer and shorter as the sheep grow older.

It is also necessary to see how much yolk the ram's wool contains. If the animal is to live in a dry, hot climate, its wool must contain a con-

siderable amount of white, fluid, clean yolk ; it is better that there should be too much rather than too little yolk, especially if the animal's food is poor and wanting in succulence. On the other hand, a ram reared in a hot climate will secrete more yolk when it is taken to a colder region, therefore all that is necessary is that the ram produces sufficient yolk to keep its wool healthy and unmatted. A ram should never be purchased with thick, pasty, yellowish yolk, as this is very difficult to remove by washing.

F. S.

428. Comparative Value of Corriedale and Dorset Horn Rams for the Production of Fat Lambs.

HINTON, F. B. (Sheep and Wool Expert). Lamb-Raising Trials, Corriedale versus Dorset Horn. *The Agricultural Gazette of New South Wales*, Vol. XXXIV, Part. 3, pp. 171-174. Sydney, 1923.

Two lots of Border Leicester \times Merino ewes (first cross) were mated respectively with 10 Corriedale rams and 10 Dorset Horn rams. The number of lambs dropped was 396 for the first lot (18 being twins) and 407 for the second (21 twins). The increase in live-weight of the two lots of lambs at the ages given was respectively : 2-3 months, 11.6 and 13.7 lbs.; 3-4 months: 12.2 and 13.5 lbs.; average at 5 months, 74.2 and 82.4 lbs. When five months old, they were respectively sold at the average price of 17s. 7 $\frac{1}{3}$ d. and £1.0s.1 $\frac{1}{2}$ d., or a difference of 2s 6 $\frac{1}{2}$ d. per lamb in favour of the Dorset Horn lot. The financial returns per ewe were respectively 15s. 2d. for the Corriedales and 17s. 9 $\frac{3}{4}$ d. for the Dorset Horns. The lambs in this lot matured earlier than the others but as regards lambing losses there was little to choose between the two groups.

F. S.

429. The Influence of Feeds and Feeding on the Type of Market Hog.

ROTHWELL, G. B. (Dominion Animal Husbandman). *The Agricultural Gazette of Canada*, Vol. X, No. 2, pp. 110-115, figs. 4, Ottawa, 1923.

The authors experiments carried out on the Central Experimental Farm, Ottawa, with a view to determining the effect of feeds and feeding on the condition of fattening-hogs yielded the following results. The young pigs given a ration of skim milk with the minimum of crude fibre developed well, and their growth was little, if at all, arrested at the time of weaning, whereas another lot fed the same ration, but without the skim milk, fattened more slowly. The animals that received a mixture of meals, meat meal and milk required a little more food than those given no meal meal, but turned out fine, large, fat pigs superior to those fed on meals alone. The pigs given meals, and meat-meal but no milk, did not develop properly ; they were deficient in length and other qualities and too big.

Two lots of pigs of the same breed and type as those used in the above experiment were fed on maize, oats, sharps, and meat-meal, but one lot was given these rations unmixed and distributed by means of an automatic feeder, while the rations of the other lot were mixed and given in limited

amounts. It was found that the first lot preferred a ration containing about 80 % maize, and fattened quicker than the second lot, which consumed less grain per lb. increase in live-weight and was classed in the select category. The other lot of animals was a little fatter and taller, especially at the shoulder. These experiments all show that any system of feeding that tends to cause too early a formation of fat in hogs fattened for bacon, and hinders maximum bone and muscle development during the first 4 months, has the effect of producing fat, short-bodied animals lacking in uniformity.

The observations of many years have also proved that it pays better to fatten hogs in cheaply constructed enclosures, rather than in closed piggeries, in which they do not grow, such a good shape. F. S.

430. The Value of a First Cross in the Production of Pork and Bacon.

The Journal of the Ministry of Agriculture, Vol XXIX, No 10, pp 939-941. London, 1923

During the winter of 1921, an experiment was carried out at the Lord Landsworth Institute at Long Sutton (Hampshire, England) for the purpose of determining the value of a first cross between the Berkshire and Large Black breeds of pig from the point of view of lard and bacon production. The experiment lasted 113 days; during this period the 9 Large Black pigs increased 471 kg. in weight and consumed about 1576 kg. of mixed rations, while the 9 first cross Large Black \times Berkshire hybrids gained 553 kg. in weight and ate about 1732 kg. of mixed rations. The rations varied according to the different periods, and were not quite the same for the two lots. The composition of the rations is given in the paper. The experiment shows therefore that the first generation hybrids matured earlier than the pure-bred animals, and required only 3.1 kg. of food for each kg. of increase in live-weight, whereas the pure-bred swine consumed 3.3 kg. of rations per kg. of added live-weight. F. S.

Bee-Keeping.

431 Foul Brood.

Ministry of Agriculture and Fisheries, Leaflet, No. 32, 6 pp., figs 2. London, 1923.

There are three varieties of foul brood : the virulent form with strong smell due to *Bacillus alvei*, the odourless type caused by *B. Burri*, *B. Brandenburgensis* and *B. Larvae*, and the foul brood of which the pathogenetic agents are *B. Guntheri* and *Streptococcus apis*. The latter often accompanies virulent foul brood and does not form spores. The bacilli can be seen at the beginning of the disease, but when it has reached an advanced stage, they form spores and disappear. The spores are resistant to freezing, carbolic acid, thymol, salicylic acid, naphthol β , perchloride of mercury, creoline, lysol, oil of eucalyptus and naphthaline. The last 4 substances, which become volatile at the ordinary temperature of the beehive, hinder

the growth of the bacilli, but have no effect upon the spores which can be placed for two months in a solution containing 5 % of carbolic acid, or immersed for 15 minutes in boiling water without any injury. The disease must therefore be controlled during its early stages. For the prevention and cure of foul brood, the author recommends the following measures :

1) When the bee-keeper has been in contact with an infected colony, he should wash his hands and disinfect his implements with carbolic soap, or with a solution of carbolic acid (Calvert's No. 5) mixed with 12 times its weight of water. Before washing his hands or implements, he ought to remove by means of a little alcohol (pure, or denaturated), all the infected matter that is insoluble in water.

2) If a weak colony is infected, it is best to destroy the bees, combs, frames and covers, and to disinfect the hive. The bees can be killed by pouring a saturated solution of potassium cyanide into the brood-nest, care being taken to previously close any apertures by which the gas can escape. Another method is to suffocate the bees by passing sulphur fumes into the brood-nest. The dead bees, together with the combs and covers ought to be buried to avoid infection. The operation is best carried out at night when the bees stop flying. It is necessary to disinfect the hive also, this may be done by flaming the inside with a soldering-lamp or covering the internal walls with paraffin or petrol and setting fire to these substances.

3) If the disease breaks out in a strong colony, the bees can be saved by making them swarm artificially into a box or basket, and shutting down the lid. Care must be taken to insure their having sufficient air. The colony is then put in a cool place for 48 hours and fed ; after this interval, the bees are put into a hive with movable frames and treated like a swarm being given syrup mixed with Naphthol β and kept moderately warm. Any of the insects that die during the treatment should at once be burnt.

When the disease occurs in a light form, fumigation or disinfection is sufficient ; this may be effected by suspending from the division-wall a sponge or piece of flannel soaked once every 6 days in 40 gm. of formalin, 2 balls of naphthaline being left during this time in the brood-nest.

F. S.

432. Control of Isle of Wight Diseases in Hive Bees (1).

ANDERSON, J (North of Scotland College of Agriculture). *The Scottish Journal of Agriculture*, Vol VI, No 2, pp. 183-191, bibliography. Edinburgh, 1923

Description of the spread of the Isle of Wight disease of bees in England, and to the suggested means of control. The author states that in recent years, however, the damage has been less virulent in Great Britain, and that the number of resistant hives is on the increase. This is considered to be due to natural selection of resistant bees and points to the advisability of

(1) See R. 1922 No. 463 (Ed.)

replacement of queen bees susceptible to attack by others coming from hives free from attack. The queen should be introduced into the hive at the beginning of the season to ensure a good brood during the winter.
F. S.

433 Larvae of the *Meloe cavensis*, Injurious to Bees in Cyrenaica.

ZANON, V. *L'Agricoltura coloniale*, Year XVI, No 10, pp. 345-354 Florence, 1922

Description of the Coleopteron *Meloe cavensis*. The larvae hidden in the flowers, attack the bees and cause their subsequent death. The injured bee returns to the hive and the deleterious effect on the swarm is evident. Naphthalene sprinkled on the floor of the hive only acts as a palliative

The only means of prevention appears to be in the case of large swarms where the workers hinder the entrance into the hive of enemies or chase them out as quickly as possible.
F. D

434 *Caltha Palustris*, the Cause of May Disease.

GREMARD E. Maikrankheit und Dotterblume. *Schweizerische Bienen-Zeitung*, Year XLVI, No. 2, pp 88-89. Aarau, 1923

The author, a bee-keeper at Bettlach (Solothurn, Switzerland), noticed that May disease made its appearance among his bees, and in his neighbours' apiaries, in years when *Caltha palustris*, the marsh marigold, flowered before the cherry-trees. He therefore carried out the following experiment in the spring of 1921, in which season the above-named conditions were found. All the swarms except two were kept in the apiary until the cherry-trees were in blossom, the two swarms that were at liberty contracted the disease, as did all the bees of the neighbouring owners, but the swarms shut up in the apiary remained immune. The bees attacked, or killed, by the May disease, together with some flowers of *C. palustris*, were forwarded for examination to the Bacteriological Institute of Liebefeld (Berne). It was found that the bees had not been infested by any parasite, but that their intestines contained a large amount of *C. palustris* pollen. Although the marsh-marigold had been believed by many persons to be the cause of May disease, all experimental proof had hitherto been wanting
F. D

435 Renewal of the Combs in Bee Hives.

AYME, H. Le renouvellement des rayons *Journal d'Agriculture pratique*, Year 87, Vol I, No 2, pp 32-34. Paris, 1923.

The author has noticed that when bees instinctively realise the necessity of renewing their combs, this knowledge often comes to them rather late, and that man can supply their needs in this respect in a more timely and satisfactory manner. Experience has proved that when a colony does not thrive, in spite of having been provided with plenty of

food and with a young queen, this is to be attributed in nine cases out of ten to the hive being too old, or having been accidentally deprived of its queen, with the result that the central combs serving as brood-combs are in a bad condition. The remedy consists in the removal of all old frames containing neither brood nor honey, and their renewal by new frames. If the old ones contain some honey they can be placed at the ends, but as soon as the brood has hatched out, such defective frames should be entirely discarded. By the adoption of this system, two years are amply sufficient for the complete renewal of the brood-combs in a hive with 12 to 14 large frames. The use of corrugated wax greatly facilitates this operation which, in the opinion of the author, should be carried out every 6 years, though in order to disturb the bees as little as possible, it is well to renew 2 or 3 combs every year instead of substituting 5 or 6 new ones at a time.

The deterioration of the combs is due to 1) the cavities of the cells becoming reduced in size owing to accumulation of the outer silky coverings left behind by the chrysalides, 2) the bees, or some of their enemies, gnawing the cells, 3) the excess pollen deposited by the bees upon the combs surrounding the brood-comb. This pollen decomposes in time and is the chief cause of the necessity to renew the combs. The combs can, however, be cleansed by washing, they are left to soak for 24 hours in tepid water, after which a small jet of water is directed upon each comb in turn. If the operation is not successful, it is necessary to scrape away the cells with a knife until the corrugated wax is exposed, when the bees will construct new cells upon it in the same manner as they do upon new corrugated wax.

F S

Sericulture

436 **Sericulture Improvement in Southern China.**

HOWARD, C. V (Professor of Sericulture, Canton Christian College) the *Lingnaam Agricultural Review*, Vol I, No 1, pp 31-46, 3 tables College of Agriculture, Canton Christian College, Canton, 1922.

PRESENT CONDITIONS OF SERICULTURE IN SOUTHERN CHINA — Southern China is more or less isolated, both geologically and ethnologically, from the rest of China. It has little connection with the Northern part of the country and communicates with the Western States almost entirely by means of Shanghai, which explains the fact that silkworm rearing in S China has not made the progress to be expected from the favourable conditions of the surroundings, the rare quality of the breeds raised, the good type of silk produced, and the excellent organisation of the production and sale of mulberry leaves and of silk.

Most of the silk-breeding treatises, even those written in Chinese, do not consider the question of sericulture in South China, but only deal with the industry as practised in Northern and Central China where the conditions and methods obtaining are totally different.

Sericulture is carried out in the Province of Kwangtung, in the Delta region over an area of about 150 sq kilometres, between Canton, Hong-

kong and Macao ; in the valleys of the West River and the Kwangsi (as well as in the Province of Kwangsi) ; north of Canton and Swatow ; in the island of Hainan, etc. ; the total area may be estimated at some 1500 sq. kilometres. This area could well be quadrupled, while by the production of healthy " seed " and the selection of the breeds of silkworms reared, the amount of silk obtained from the present sericultural area could easily be increased three or five fold.

Since no statistics are available, it is not possible to estimate the total silk output of Southern China. The reeled silk production for the Province of Kwantung for 1921 has been reckoned at 315 100 pikuls (or about 42 million lbs.) It is certain that the amount of silk used locally far exceeds the quantity exported, but as a rule, the selected cocoons are sold to spinning-factories provided with modern appliances and working for export, whereas the cocoons of second quality are reeled at home and the silk is woven in the local factories.

Canton exports from one half to two-thirds as much raw silk as Shanghai, although its supply area is only one-tenth of the size of the district drawn upon by the latter port, for in Northern China only bivoltine silk worms are kept, while in Southern China six broods are reared annually.

The amount of raw silk exported from Canton rose from 39 789 bales in 1918 to 61 566 bales in 1921, during the same period it rose in Japan from 235 822 to 261 265 bales. Canton exported 15 451 bales of raw silk to the United States in 1918 and 48 057 in 1921, the number of bales sent to Europe being respectively 24 338 and 13 509. Canton silk crêpes are rapidly gaining favour in North America.

Canton silk is of a special type and resembles the silks of Tonkin, Siam and India being quite distinct from Shanghai silk, that is to say, from the products of Northern China, Japan and Europe. Its fibre is thinner, softer, more glossy and better adapted for the manufacture of special textile fabrics such as crêpes and velvets.

SILKWORMS REARED -- These belong to two varieties, one bivoltine (bred in the spring), and the other polyvoltine producing six broods annually, the breeding season lasting from the end of January until the end of October. Both kinds of silkworms produce the same quality of silk which is soft and very glossy, they also make the same type of oval, white cocoon, although those of the bivoltine breed are larger and the fibre of the silk is somewhat coarser. The bivoltine variety is called "Taai Tso" and the polyvoltine "Lun Uet"; the latter name has, however also been given to a hybrid between the two varieties which has taken the place of the parent of the same name.

Five weeks elapse between the hatching out of this hybrid and oviposition. The two first generations have thin-skinned eggs of a light colour (cream) and hatch naturally from seven to ten days after they are laid. Some of the eggs of the third generation and all those of the three following layings are dark coloured and have thick skins. They do not hatch naturally until the following January. The immediate hatching of the dark eggs can, however, be induced by their immersion for a few seconds in boiling water on the morning following their deposition. This is a very

delicate operation and only a few persons know how to perform it which is probably one of the reasons for the silkworm "seed" trade in Southern China remaining in the hands of a restricted number of individuals.

Forced hatching is a cause of weakness, and the ill effects are intensified by defective methods of rearing the silkworms which are kept with insufficient space in damp unventilated huts and crowded together in the breeding trays with the inevitable result that the mulberry leaves are wasted and become fermented, etc. This explains why 50-70 % of the "seed" on the market is infected with pebrine and accounts for the slow progress made by the industry.

THE WORK OF THE CANTON CHRISTIAN COLLEGE. — At first, direct propaganda was started among the peasants and an effort was made to insure the production of only healthy "seed", but a great difficulty was encountered in the latter connection chiefly because in the case of the polyvoltine breed there is not sufficient time for the microscopic examination of the eggs, since these must be immersed in hot water the morning after they are laid.

The Silkworm-Rearing Section of the College therefore confined itself to examining only the seed from which its own silkworms were to be reared, and distributed without any inspection the seed obtained from its stock. The result was that febrine increased in every generation, so that while only 0.5 % of the silkworms reared at the College are infected, on an average, the percentage of infected seed proved to be 1 in the case of the distributed eggs, and 50-80 in that of the silkworms produced locally. Further, the silkworms and cocoons obtained at the College were larger than any of the others.

The College began its work in 1919. The first year it had to overcome the prejudice against its "chemical eggs", as they were termed by the natives, and was obliged to sell "seed" at one-tenth of the market price, although now its worth has been realised, it fetches a price four-times as high as all the others and the supply cannot by any means keep pace with the demand. Local dealers purchase, by preference, cocoons produced by silkworms reared from the College eggs.

The College also carried out propaganda by means of short seasonal courses for silkworm rearers and silk reelers, half-yearly competitions, the construction of silkworm breeding huts of the native type but improved at little expense, and by the inspection of the broods raised from eggs supplied by the College, etc. A years' course of instruction is held for the training of the technical Staff.

F. D.

Pisciculture.

437. **Restocking Streams.**

DE LACHADENEDE, Notice sur le repeuplement des cours d'eau dans le Tarn et sur la Station d'incubation de Lampy. *Revue des Eaux et Forêts*; Vol. LXI, No 1, pp. 16-21. Paris, 1922.

France imports 4 million kilos of fish every year, which ought to be supplied from her own rivers and streams. It is with this object that the

following efforts have been made in the Department of the Tarn, which has 413 km. of trout streams. They relate to:—

- (1) the production of trout ova;
- (2) their hatching

Hitherto the ova of Salmonidae have been produced in stations where the breeding fish have been kept in basins. But in this way young fry are obtained which are not hardy. Consequently an attempt has been made to obtain, in a practical and economical manner, ova from breeding fish in a free state. The locality selected was the basin of the Lampy in the Black Mountain. The Lampy stream, which is the only stream fed from this basin, forms a bend down stream. At this point there is a forester's house and a Station has been made consisting of a fishery, confined basins and a hatchery.

1. *The Fishery* — The bend in the stream has been cut across by a ditch 0.50 m wide. A net blocks the downstream opening. An elongated basin has been arranged between the entrance and the exit. When the trout go up stream to spawn they pass up the ditch, for the stream is blocked, and they get into the net where they are caught.

2. *The confined Basins* — The trout which go up stream have not all reached sexual maturity. While waiting until they are mature the fish are kept in two basins of running water, after sorting the sexes. The time when sexual maturity is attained must then be ascertained by frequent observations. For this, the basins are emptied by means of a sluice without however emptying a hollow in which the fish collect and are easily caught in a landing net.

3. *Hatchery* — 8 double troughs of oak with 2 stages of perforated zinc platforms are fed by a spring whose water has been decanted and filtered. Each trough can hold 26 000 ova per stage. The total content is therefore 400 000 ova. The first results were obtained in 1921-22; but they were spoiled by drought which caused loss and delay in the capture of the breeding fish. From the 11th December to the 24th February, 310 male fish and 398 female fish were caught. The females, which averaged 200 grammes in weight, gave 162 000 eggs. The eggs when kept at a temperature of 4° to 6° C began to hatch after four days.

The mortality varied from 3 to 30 % according to the screens, in proportion to the insufficient sexual maturity of some of the trout and want of aeration in some of the water; clear river water gave better results than spring water.

Small fry Stations. — The small fry were kept in fixed Stations until May. They were then taken to the stream to be restocked. But such transport is difficult and costly.

Moveable stations are formed of transportable cases. Flannel filters are arranged on the side through which the water enters, then a large compartment into which the water enters from below and in which is arranged a screen of perforated zinc half way up. The water passing across the eggs flows out through the upper part of the opposite side. This small and very portable apparatus can be put up anywhere where there is a streamlet and can be looked after by inexperienced persons.

This method of restocking has, moreover, interested the people of the mountains who have seen it in use and its application by them has thus been facilitated

R. D.

438. Purification and Utilisation of Drainage Water by means of Carp Breeding.

LECLERC, M. J (Inspecteur adjoint des eaux et forêts) La pisciculture in Alsace Lorraine *La vie agricole et rurale*, Year II, Vol. XXI, No. 38 pp, 215-216. Paris 1922

In Strasburg (Wachen) there is an interesting establishment for the purification and utilisation of drainage water. The water is directed through underground channels and filtered through a screen with a 7 mm. mesh which collects a deposit of about 5 % of material. It is then directed into settling tanks with well-sloped sides and narrow base and hollowed out to form a channel. A longitudinal wooden sluice gate is lowered from time to time to close the exit of the channel and the latter consequently acts as a conduit and the force of water drives out the deposit. The water then flows into a well, where fermentation takes place and the matter is rendered scudable and only a small deposit remains which every three months is cleaned out. The sludge is utilised by farmers as a fertiliser.

The water from the settling tanks, still containing 7-8 % foreign matter is mixed in varying proportions with from $\frac{1}{2}$ to $\frac{1}{3}$ its bulk of fresh water coming from another source, and the combined stream of water then flows into the purification tanks, each of which covers 0.5 hectares with an average depth of 1.20 metres. The water is distributed by means of a stone channel, width 0.20 m., with transversal pipes, 6 to 8 metres apart. This assists oxygenation of the water and regular distribution. Overflow exits are arranged.

In the purification tanks a collection of carp fry are placed. The organic material suspended in the drainage effluent results in large swarms of entomostriacae, which act as purifiers, and absorb all the organic material, including the bacteria, and the young carp seem to flourish on this form of nourishment.

During the winter the carp hibernate at a depth of 2.5 m., they however, continue their beneficial work, although with somewhat less vigour.

The Wachen centre covers an area of not more than 3 hectares, quite insufficient to meet the demands of the city, this would necessitate some 70 hectares calculated at the rate of 1 hectare per 3000 inhabitants.

F. D.

BIBLIOGRAPHICAL NOTES.

- 439 ADERSEN, VALD The Curative Properties of Glandular Serums. Eksperimentelle Undersøgelser vedrørende Kvoerkeserum *Meddelelser fra den kgl. Veterinær-og Landbohøjskoles Serumlaboratorium LXXXIII*, 13 pp. Sortryk af Maanedskrift for Dyrloeger, Vol. XXXIV, 1922. Stockholm, 1922

An account of experimental research made in the Serological Laboratory of the Royal Higher School of Veterinary and Agricultural Science

of Stockholm, on the curative action of glandular serums. The results, which are also summarised in German, show these serums to have not only a prophylactic effect, but also a very active curative effect.

F. D.

- 440 PHILP, T. (Chief Government Veterinary Surgeon), Osteomalaxy in Cattle *Department of Agriculture, Tasmania, Bulletin* 109, 2 pp. Hobart, 1922.

A short description of osteomalaxy in cattle, its causes, treatment and prevention.

F. S.

- 441 ADERSEEN, VALD Kan Serumbehandlung forebygge Streptokokpycemi hos Føl? *Meddelelser fra den kgl Veterinær-og Landbohøjskoles Serumlaboratorium*, LXXIX, Soertryk af den Kg. Veterinær-og Landbohøjskoles Aarsskrift 1922, pp 110-132 Stockholm, 1922.

Description of the experiments carried out in the serum Laboratory of the Royal school of Veterinary Hygiene and Agricultural Science, Stockholm to test the value of serums for the cure of the streptococcus pyæmia. The results obtained were negative

F. D.

- 112 CHRISTIANSEN M General Mucormykose hos Svin *Meddelelser fra den kgl Veterinær-og Landbohøjskoles Aarsskrift* 1922, pp 133-180, fig + 2 tables separate from text, bibliography Stockholm, 1922.

A description, followed by a summary in German, of two cases of general mykosis produced in swine by *Mucoraceæ*, one of which was a form very nearly related to, or identical with *Rhizopus equinus* Constantin and Lucet var. *annamensis* P. Noel, while the other was *Absidia ramosa*, var. *Rasti* Ledner (*Mucor ramosus* Lindt.)

F. D.

443. DOMATHEN, A Les maladies microbiennes des volailles en Algérie *Revue Agricole de l'Afrique du Nord*, Year 21, No 186, pp. 122-124, No. 187, pp 134-136, No 188, pp 148-151, fig 1 Algiers, 1923

The author describes all the bacterial poultry diseases known in Algeria (bird-pox, contagious epithelioma, fowl diptheria, contagious coryza, ophthalmia, avian tuberculosis, white diarrhoea of chicks, cramp, fowl typhoid) and describes the means of diagnosing these maladies, the samples to be sent to the laboratory and the best control methods.

F. S.

444. DECHAMBRE, P. La consommation des betteraves (*The consumption of beet-roots*) *Revue de zootechnie. La Revue des Éleveurs*, Year 2, No. 2, pp 144-146. Paris, 1923

Practical advice as to the use of beetroots in the feeding of domestic animals with a description of the mischief caused by damaged beetroots.

F. S.

445. RADISSON, M (Ingénieur agronome, Institut d'agronomie coloniale, Nogent-sur-Marne) Causes et conséquences de la Transhumance chez les tribus du Moyen-Atlas *Revue de Zootechnie La Revue des Éleveurs*, Year 2, No 1, pp 33-44, fig 4, maps 2, graphic 1, No 2, pp 140-152, fig 3 Paris, 1923.

The author gives a detailed account of the causes determining the travelling of flocks in the different parts of the Middle Atlas and mentions the advantages that sheep-breeding and colonisation may derive from the practice. F S

- 446 WILLAERT, L. Elevage et les races d'animaux domestiques dans l'Uelé (Congo Belge) *Bulletin agricole du Congo Belge*, Vol XIII, No 1, pp 3-43, plates 1, figs 7 Brussels, 1922

Detailed description of the rearing of domestic animals, under four headings natural distribution considered from the stock raising standpoint, domestic breeds (cows, sheep, goats, horses, donkeys, mules, poultry), hygiene diseases; of animals F S.

- 447 PARENTI, E, Allevamento e razze di animali domestici nell'Uelé (Congo belga) *L'Italia agricola*, Year 60, No 2, pp 81-82, 1 table Piacenza, 1923

A brief review of the breeding of the Belgian horse in Italy which was begun in 1907 in the Province of Piacenza, and in 1908, in that of Cremona. Belgian horse-breeding centres are confined to the Provinces of Cremona, Mantua and Piacenza whence the animals are sent to the neighbouring Provinces of Bologna, Ferrara, Alessandria and Vercelli.

The author gives the names and addresses of some of the best breeders. F D.

- 448 OTTO Die Brennpunkte der Gemeindebullenhaltung The Main Difficulty in Community Bull-Keeping *Deutsche Landwirtschaftliche Tierzucht*, Year 26, No 49, pp 517-518. Hanover, 1922

The crux in the keeping of a common stud-bull lies, according to the author, in the great difficulty, owing to the constant fluctuations of the exchange, in fixing a service-fee proportionate to the maintenance cost of the animal. He therefore suggests that the service-fee should be paid in kind, and preferably in forage, which is the chief item in the expenditure. F. D.

- 449 BARBIER, A. (Directeur des Services vétérinaires de la Côte-d'Or). La Race Tarantaise et son Concours spécial en 1922) *Revue de Zootechnie*, No 5, pp 486-498, figs 5, bibliography. Paris, 1922.

On the occasion of a special show of the Tarantais breed held at Chambéry, the author gave an account of the origin of these cattle and described their characters and breeding. He also mentioned the improvements that might be made in the animals, and the markets for their products. The article contains the scale of points adopted at the Show. F. S.

450. DECHAMBRE, P, La Production bovine de la Bretagne *Revue de Zootechnie. La Revue des Éleveurs*, pp 94-102, fig 4. Paris, 1923

A study of the natural surroundings (soil and climate) of the cattle of Great Britain, together with an account of the distribution of the breeds and the differences shown by the stock owing to crossing and the admixture of races. Suggestions for the improvement of cattlerearing in Great Britain
F. S.

451. ROSE, H A Belted Galloways *The Scottish Journal of Agriculture*, Vol VI, No 2, pp 163-166, figs 4, Edinburgh, 1923

A short account of the development of the Belted Galloway breed of cattle. The author gives the characteristics and capacities of the present animals and states that a Herd-book is being started
F. S.

452. *Ministry of Agriculture and Fisheries, Leaflet*, No 388 The Feeding of Dairy Cows, pp 10 London 1923

This leaflet contains a practical account of the rules to be observed in feeding dairy cows, and gives examples of the composition of maintenance and production rations in winter and summer, the method of estimating the feeding value of such rations, the effect of certain foods on milk and butter, and of certain preparations on the digestibility of food. It also provides a list of the chief feeds showing their digestible starch content, starch value and nutritive proportions
F. S.

453. SPÖTTEL, W and TANZER, E Über Eigenschaften und Vererbung der Wolle bei Leicester-Merino Kreuzungen The Wool of Leicester-Merino Hybrids, its Characters and their Transmissibility *Deutsche Landwirtschaftliche Tierzucht*, Year 26, No 49, pp 518-522, 1 fig Hanover, 1922

A critical review of the work of preceding investigators and an account of the authors' own researches as to the characters of the wool of hybrids resulting from the Leicester-Merino cross and the extent to which the parental qualities of fleece are inherited by the offspring.

A careful study of the fleeces of pure-bred Merinoes and Border-Leicesters and of the fleeces of their crosses shows that it is a mistake to suppose that the wool of the hybrids is composed of more numerous or more variable types of fibres than the wool of the parent breeds.

F. D.

454. LAWRENCE, E (President of the Devon Long-Wool Society) Devon Long-Wool Sheep. *The Journal of the Ministry of Agriculture*, Vol XXX, No 2, pp 126-129, figs 2, London, 1923

This paper gives an historical account of the Devon Long-Wool breed of sheep, describing its characters and aptitudes, and the points requiring special attention in the selection of the rams and ewes. Mention is also made of the places and dates of the chief markets where the rams of this breed are sold.
F. S.

455. FRANCIS, P. A. (Ministry of Agriculture and Fisheries) The Importation of Continental Goats *The Journal of the Ministry of Agriculture*, Vol XXIX, No 11, pp 1023-1028, figs 4 London, 1923

The author takes advantage of the arrival in England of a consignment of Saanen and Toggenburg goats, to give some information on the subject of these two breeds which are largely reared in Holland and Switzerland F. S

- 456 SANDERS, SPENCER, The Tamworth Pig *The Journal of the Ministry of Agriculture*, Vol XXIX, No 11, pp 1029-1032, figs 2 London, 1923

The present type of Tamworth pig is described and the standard given as established by the National Pig-Breeders' Association F. S

457. VOITELLIER, CH Exposition Internationale d'Aviculture de Paris *Revue de Zootechnie La Revue des Éleveurs*, Year 2, No 3, pp 289-246 Paris, 1923

Observations made on the subject of poultry-rearing in France on the occasion of the International Avicultural Exhibition at which nearly 10 500 head of French and foreign poultry were shown F. S

- 458 HARDY, F. W. The Intensive System of Poultry Keeping *The Journal of the Ministry of Agriculture*, Vol XXIX, No 11, pp 1001-1008 figs 2 London, 1923

This paper gives the chief rules to be observed in housing, feeding, supplying water etc to fowls with a view to intensive poultry-keeping. It also contains information respecting the building of fowl-houses, the composition of rations and other matters of interest F. S

- 459 RUSTON, A. J. (Lecturer in Farm Economics, University of Leeds) Poultry-Keeping on the Farm *The Scottish Journal of Agriculture*, Vol VII, No 2, pp 166-176, tables 5, figs 2 Edinburgh, 1923

A review of the economic condition of the egg-production industry in Yorkshire (England), together with some hints as to the better management of laying hens F. S

- 460 Ministry of Agriculture and Fisheries Leaflet No 321, Notes on Essential Points in Poultry Feeding, 2 pp London, 1923

Revised edition giving useful and practical information on the feeding of poultry and the preparation of dry and moist feeds F. S

- 461 *The Agricultural Gazette of Canada* A System of Pedigreeing Poultry Vol X, No 1, pp 40-45, figs 9 Ottawa, 1923

The author gives the scale of points for controlling and marking fowls belonging to laying breeds which has for several years been followed with complete success by the Poultry Husbandry Department of Macdonald College F. S.

462. LADEBECK, F. Die Farben einiger Hühnerrassen. *Zeitschrift für induktive Abstammungs- und Vererbungslehre*, Vol. XXX, Parts 1-2, pp. 1-62, bibliography Berlin, 1922

This article on the colouring of different breeds of fowls includes: an account of the morphology of the feathers and of the pigments of the plumage, a comparative chemical study of the different pigments, and a description of the colour of the comb, ear-lobes and feet. It is a contribution to the solution of the problem of the isolation of the various hereditary factors of a transmissible character, which is in this case the colour of the plumage. F. D.

463. RICHARDSON, F. C. Recent Developments of Rabbit-Keeping for Fur. *Journal of the Ministry of Agriculture*, Vol. XXIX, No. 11, pp. 1019-1023, figs. 3 London, 1923

A description of the present condition of the industry of breeding rabbits for fur, and of the rabbit fur trade in England. F. S.

464. GIRARD, H. (Président du Club français du Chien de berger) Nos Chiens de Berger. *Journal d'Agriculture pratique*, Year 89, Vol. I, No. 13, pp. 257-259, figs. 2 Paris, 1923

In this article, the author urges the farmers of France to rear fine, pure-bred sheep-dogs instead of mongrels. He draws attention to the fact that there are about 10 million head of sheep in the country which, at the rate of 1 dog for a 100 sheep, means work for 100 000 sheep-dogs.

F. S.

FARM ENGINEERING.

Machines and Implements

465. A Tractor worked on Palm Oil.

GASTHUY, P. Rapport sur le concours de Tracteurs à l'huile de palme organisé par le Ministre des Colonies à Bruxelles, en 1920-1921. *Bulletin des Matières Grasses* (reproduced from *Bulletin Agricole du Congo Belge*), No. 2, pp. 40-63. Marseilles, 1923.

In September 1921, at the Exhibition of Colonial Tractors organised by the Belgian Colonial Office, the Stockholm firm, SVENSEN, exhibited a tractor worked on palm oil, called the "Avance" tractor.

This tractor-plough which is described in detail, weighs 2900 kg. and consists of two breasts which are easily regulated automatically,

for lifting and earthing and are attached to the frame by means of strong springs. If the plough encounters an obstacle the springs yield and the engine is disconnected immediately; this renders the tractor inactive which prevents damage, especially on dry, hard soils such as are met with in the Colonies.

This semi-Diesel two stroke engine is easily worked, durable and suitable for use with vegetable oils, petrol or paraffin. A special cylinder is supplied for palm oil and other fatty fuels, of the consistency of butter or solid, and an aluminium reservoir for the liquefaction of fatty substances. The heat which is transmitted from the cylinder to the walls of the reservoir is sufficient to melt the combustible substance.

Tests. — The engine is of the single cylinder type, upright, double stroke, provided with a heat bulb (partly cooled) and arrangements for an air blast. The characteristics are: 10 HP normal, diameter of cylinder 174 mm.; piston stroke 186 mm.; number of revolutions 550 p. m. When palm oil is used as fuel this is calculated at 579 revs. per minute, which is, according to pulley strength 9.96 HP., fuel consumption from 322.4 gm. per b. h. p. per hour.

Using heavy mineral oil, the number of revolutions is estimated at 572; pulley strength of motor, 10.08 HP.; fuel consumption 261.9 gm. per b. h. p. per hour.

No deviations were noted during the 30 minutes trial.

Practical trials. — The tractor moves automatically along the ground at a rate of 3.8 kilometres per hour, gives no trouble and does not cut up the roads over which it passes.

a) *Ploughing tests.* — On September 6, tests were made, using petrol, along the edge of a field of heavy soil, beaten down in places by the passage of vehicles and extremely hard after 6 months of severe drought. The details of the work were as follows. 1 hectare ploughed in 5 hrs. 45 min. to a depth of 14-16 cm. at a uniform speed of 3.6 km. per hour. fuel consumption of heavy oil, 19.05 kg. or 21.9 litres (cost. 30 centimes per litre). Hence, the cost of fuel is considerably less than for petrol, with which the results compare favourably.

On September 7, tests were made with palm oil. Under the same conditions, the fuel consumption amounted to 23.4 kg. of palm oil. This was crude and very impure. The double filter reservoir worked excellently and during the 4 ½ working hours there was no interruption caused by any obstruction in the compressor.

b) *Road trials.* — The tractor, apart from the plough, was attached to a farm wagon with 3 wheels, weighing 700 kg. and carrying a load of 1000 kg. On the firm road, the towing proceeded satisfactorily, but on the sand, the wheels sank to a depth of 26 cm., as the steel tyres are too narrow, the front wheels being only 0.70 m. As in the Congo sandy soils are abundant, it will be advisable to make both the back and front wheels of greater width, and of heavier weight, which would assist handling at turnings. At the exhibition at Shrawardine (England), this machine made an excellent impression owing to its durability, simplicity and low running coat.

R. D.

466. The Valude Wheel.

Recherches et Inventions, Year 4, No., 47, pp. 197-200, figs. 3. Paris, 1923.

VALUDE has devised a wheel which allows powerful tractors and engines towing heavy weights to travel with the same ease on different soils, or on the highway. This wheel possess two systems of rolling that come into action in turn, automatically, according to the character of the ground.

The VALUDE wheel has a polygonal rim, upon the circumference of which are arranged segments of a trapezoidal form. These segments are placed perpendicularly to the lateral surface, and directed towards one of the diagonals of each rectangle formed by the successive planes of this surface. The edges of these segments thus form practically a continuous and circular rolling way, each segment beginning to roll as soon as the preceding one is entirely disengaged. On the road, the contact would be assured exclusively by the circular, exterior way and its rolling band. On hard, but slippery, ground (such as grass-land), the rolling segments being oblique, prevent skidding. On loose ground, the circular segments penetrate into the soil, and the wheel rests on both sides of the rim. It may be observed that this mode of propulsion does not displace, or dig up, the soil like that of wheels made on the paddle-system, while the top of the rim, after turning on the pivot comes out of the ground without throwing any soil behind it.

The VALUDE wheel (See Plate XXVI, Fig. 88) has been mounted on agricultural tractors and trials have been made at the works of the P. O. F. M. L. A. Society, at Villetaneuse. The use of these wheels caused no serious impediment to the progress of the tractors. Dynamometric comparative experiments conducted with VALUDE and ordinary wheels with gripping rims showed that the VALUDE wheels are in no wise inferior to the present types of wheel from the point of gripping, while they have the advantage of travelling on the road without any preliminary adjustment.

Other tests made at Pierrefonds proved that in order to avoid the lateral displacement of the apparatus as a result of the strain of traction, the segments on the rims of the two wheels must be arranged in symmetrical positions, and not placed parallel.

Finally, experiment has proved the ground covered by the tractor to be somewhat less than the distance covered on the soil by the polygonal perimeter of the wheel, and *a fortiori*, of the external revolving circumference. This slipping is of a kind to cause great loss of power. It may, however, be assumed that the improvements to be made on this, the first model, will prevent this loss of headway.

R. D. *

467. Plough with Tractor for Level Ploughing.

DESSAISAI, R. *Journal d'Agriculture pratique*, Year 87, No. 11, pp. 218-220, figs. 2 Paris, 09 2.

French agriculturists generally consider that level ploughing is necessary for good tillage. Further, the use of mechanical tractors has given rise to the demand for machine-drawn ploughs capable of ploughing in

[466-467]

the same way as a double two-way plough drawn by a team. The Véga plough has been devised by BOCHET to meet this demand.

It is modelled on the ordinary double two-way plough, but as the work of turning two or three shares at the end of a furrow cannot be carried out by a driver, the tractor is made to turn the plough when it turns itself to begin the new furrow. At this moment, the tractor makes a rotatory movement (in relation to the plough round a vertical axis) and this motion being transformed into a rotatory motion of the beam causes the body of the plough to return, the driver having merely to move a bolt by means of a wire.

The plough (Plate XXVII, Figs 89 and 90) consists of the body of a two-way double-plough mounted on a frame with a cranked axle. The far end of the beam which extends beyond the collar carries a bevel-pinion engaging with a part of the cogged rim of the frame. When the tractor turns, it takes a slanting position as regards the plough, and at the same time, makes the frame oblique to the beam. This deviation causes the beam to rotate, and hence return. At the same time, the support, in assuming a slanting position, exerts tension on a chain which causes the rotation of the cranked axle, and raises the plough lifting it free of the soil. The depth of ploughing is regulated by the rotation of the cranked axle. Pawls introduced on the collar keep the chassis vertical in spite of variations in the depths of the ploughing.

R. D.

468 The Use of a Manure Spreader.

TAYLOR. *Farm Implement News*, Vol 43, No 31, p 20 Chicago, 1922.

Dr. TAYLOR, Director of the Experiment Farm of Messrs DEERE, explains the advantages of a manure distributor. The apparatus insures the manure being economically spread, and it saves time, as well as increases the returns; this has been proved by the comparative experiment made by a farmer of Indiana who sowed maize, oats and clover on different plots, after first spreading the same amount of manure (12 5 tons per acre) by machine and also by hand. The results obtained are set out in the following table.

Crops	Area	Yield per acre		
		manure spread by machine	by hand	unmanured
Maize	10 acres	155 bushels	125 bushels	100 bushels
Oats	10 acres	140 "	105 "	95 "
Clover	10 acres	7 5 tons	5 5 tons	3 75 tons

G. B.

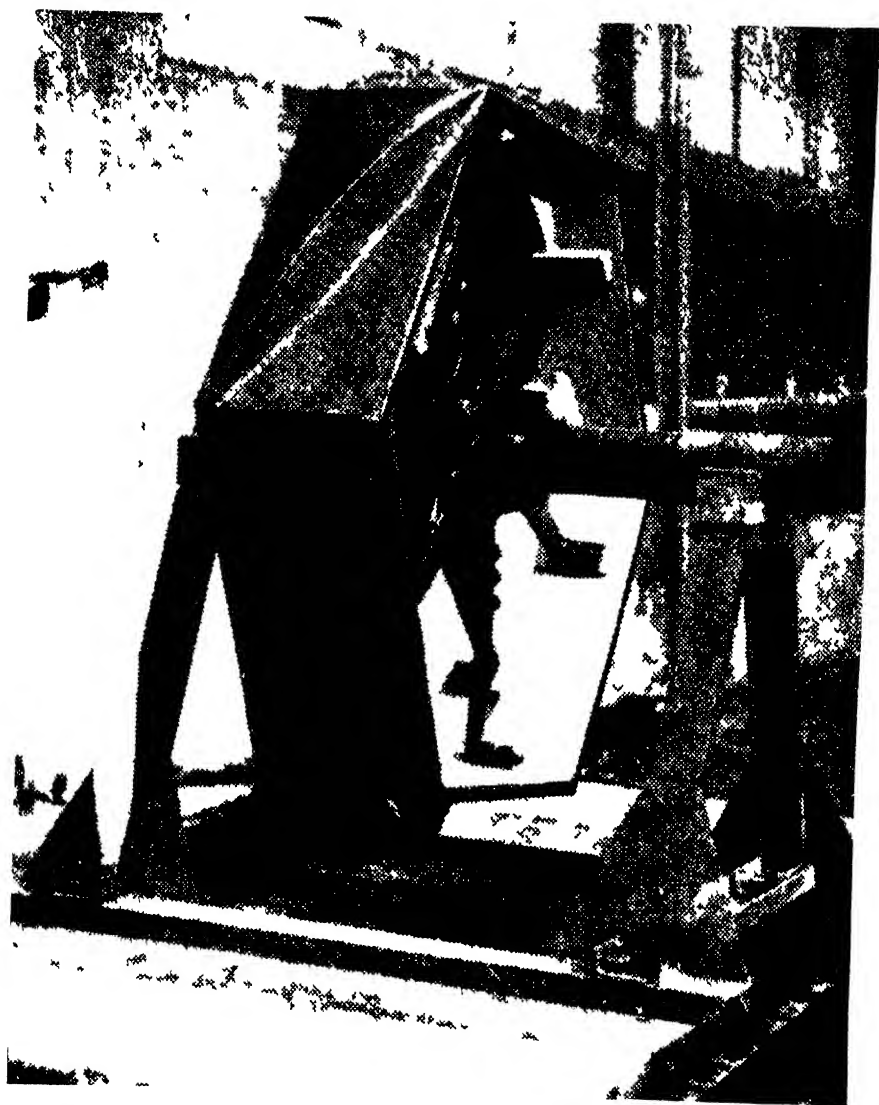


Fig. 88 Vierendeel system

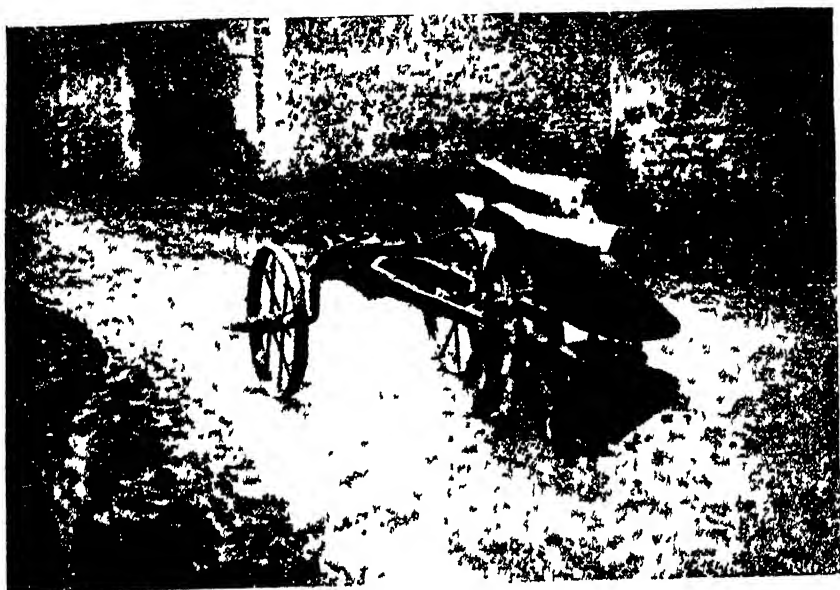


Fig. 5) — BORCHOTS' Vega plough in working position

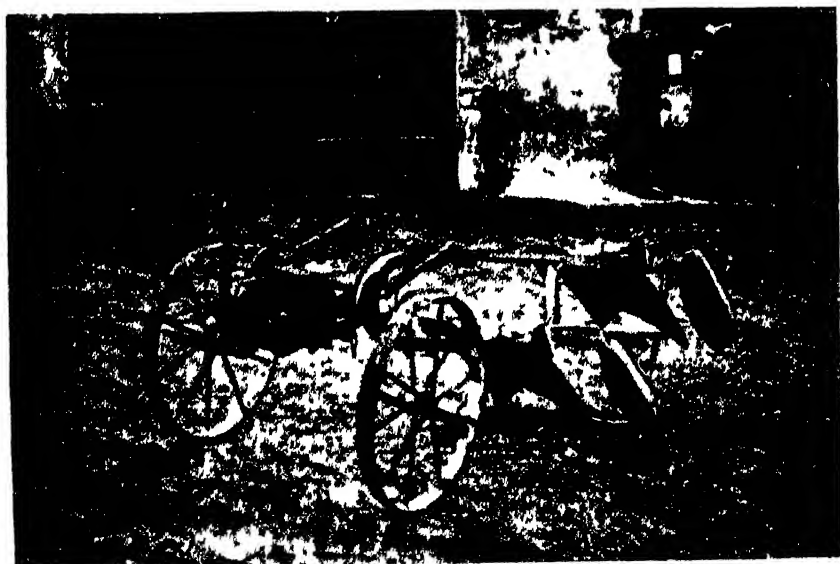


Fig. 6) BORCHOTS' Vega plough when turning

469. Harrows for Meadows.

MAURIN, G. Herse pour Prairies *Journal d'Agriculture pratique*, Vol 39, No 4, p 49. Paris, 1923

The extirpation of moss is an operation which is generally carried out in the months of February and March

DE LAPPARENT makes the following statement — “In order to encourage the diffusion of the considerable reserves of nitrogen that meadows create in the soil, it is necessary to promote the introduction of air by means of mechanical work. If there is an excess of moss it can be removed by sprinkling 200 to 400 kg of sulphate of iron per hectare and using a special form of harrow with very closely set teeth”.

For getting rid of moss the work of an ordinary harrow is very uneven but much better results are given by what is known as chain harrows fitted with teeth in the form of colters and knives. An example of this type of harrow is given in the figure annexed (Fig 91). The harrow consists of a collection of a certain number of components in the shape of a V with curved arms joined by means of rings. Each part is fitted with three teeth, one in front and two behind. The average dimensions of the furrows made by the teeth is 21 mm. The five types at present manufactured have a dimension of 1.15 metres and the following number of teeth respectively 54, 66, 78, 90 and 102, while the average weights are 50, 60, 70, 80 and 90 kg.

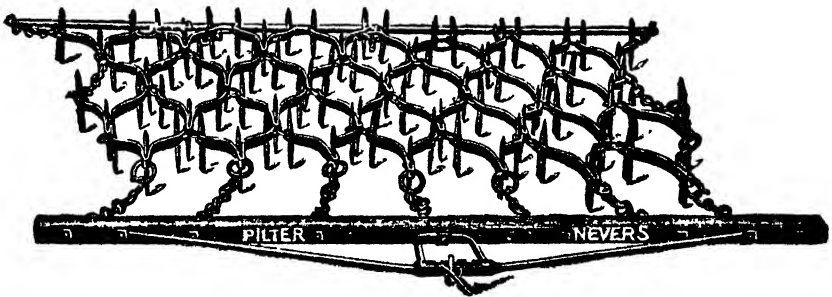


FIG. 91. — Harrow for meadows.

The different parts of the harrow are joined in front to a connecting bar made of angle-iron, and behind to an iron bar which keeps them apart though allowing the necessary amount of free movement. The teeth are in the shape of a colter on one side but more blunted on the other and have pointed ends so that they can be used for light harrowings of cereals at the end of the winter and for burying seeds scattered by hand over the surface of the soil.

E. P.

470. Equipment adopted in Sweden for the Field-Testing of Fertiliser Requirements.

VON FEILITZEN, HJ. *Nogra tekniska hjälpmedel vid utförande av Lokala fältförsök. Meddelande Nr. 228 från Centralanstalten för försöksväsendet på jordbruksområdet, 32 pp. figs. 30. Stockholm, 1922.*

The chief aim of the so-called local, field fertiliser tests in Sweden is to show each farmer what fertilisers his land requires. These tests are carried out under the directions of the Agricultural Societies of each district and by means of their employees. In order to centralise this work and render it to a certain extent more uniform, an arrangement has been made with the Central Agricultural Experiment Station of Stockholm, so that the details of the experiment schemes are worked out in collaboration with the station, to which the results obtained are communicated. The Station then reports upon each of the experiments made, recommends the most suitable fertiliser to be used and finally elaborates the material collected throughout the country, which is embodied in an annual report.

With the object of simplyfying and thereby rendering more accurate, the field-work entailed in planting, manuring and harvesting the experiment plots, the author (who was entrusted with the direction of this section at the Central Experiment Station in 1921), distributed to the organisers of the experiments a series of previously-tested implements some of which were of a new type. The Bulletin in question gives a detailed description of these implements.

One of the first conditions of obtaining useful results is that the soil should be as uniform as possible. In order to determine its character and homogeneity a borer must be used. The GERSON drill-borer made by Messrs FUNKE and Co., Berlin, has proved very well-adapted to these field-experiments. A sample-taker 35 cm. long, devised by the author, is recommended for taking soil-samples required for testing the reaction (acidity, or alkalinity).

The character of the soil of the experiment fields must be determined and described as clearly as possible in order that comparison may be made between the data of the various results. For this reason, on the initiative of the author, a collection has been made at the Swedish Geological Institute, of samples of all the most important types of Swedish soils. Small samples from the collection are distributed, packed in easily-transported boxes and accompanied with explanations and a description of the composition of each soil.

For the determination of soil acidity by the COMBER method, the author has invented a so-called Field Laboratory that enables analyses to be made easily on the spot. In the case of alkaline soils, it is necessary to estimate their calcium carbonate content which can be done from their greater, or less, effervescence in the presence of acids. A drop-bottle of hydrochloric acid is used for this purpose in the field. It should be carried in a wooden case similar to that used for fountain-pen ink-bottles.

Various goniometers are used in surveying, but the author recommends one with a pentagonal prism as being easy to handle and accurate. The

different plots of the experiment field are marked out with a measuring-tape of 650 m. that, for greater convenience, is wound round a specially constructed spool.

Ribbon-gauges of steel, or of material in which metal threads have been sewn, can be substituted so as to insure greater exactitude in measuring out the plots; the latter type is preferable, for it is cheaper and sufficiently durable.

The limits of experiment plots for cereals, or leguminosae, may be traced out satisfactorily with the "Planet Junior Firefly" plough with forecarriage. A good manure-spreader is made by J. A. ROSE of Gjørding (Denmark), which only cuts a small furrow in the grass-land.

The chemical fertilisers for each plot are weighed in little bags and sent to the place where the experiment field. The bags may be easily filled by the use of a funnel invented by L. ANDERSON (Director of Experiments) of Örebro.

Weighing-machines of different makes are used for weighing the harvest (sheaves, green forage, grass, hay, potatoes, roots). The author has carried out exhaustive tests with various types of Swedish and foreign instruments. The results, which have been published, show that the best and most accurate form for field-work is the weigh-bridge with sliding weight fixed into a graduated arm made by Messrs VIRG and VRAALSTEN of Christiania. Most of the weighing-machines are not sufficiently accurate.

The Agricultural Section of the Central Experiment Station has worked out a colour scheme for the registration of field experiments which has succeeded admirably, greatly facilitates the further study of the material and makes it easier to draw conclusions from all the data collected.

Samples of beet, for the determination of the percentage of dry matter, may be obtained by a simple machine-cutter constructed according to the Danish model, which makes it possible to cut a large number of slices off a corresponding number of beets. A special drum washes the roots before the sample is taken.

The starch content of potatoes is determined in the simplest field experiments, by means of REIMANN's hydrostatic potato-weigher which gives the specific gravity of the tubers.

In conclusion the author advises that those engaged in country work should use motor-cycles, so as to enable them to carry out more experiments.

The Bulletin is illustrated with numerous photographs of the various apparatus and implements described.

(*Corr. Sweden*).

471. **Farmers' Milling Machines: Tests Carried out in Denmark.**

CHRISTENSEN A. with the Collaboration of BILLESTRUP TH. and FRIIS SOPH. Arbegas prove med Kvoerne paa Landbohojskoen i Vinteren 1921-22.

Statens Redskabsprover 28 Beretning, 118 pp. figs. 4. Copenhagen (August Bangs, Boghandel), 1922.

The 28th Report of the State Commission for Agricultural Machinery deals with the milling tests made at the Copenhagen College of Agriculture in 1921-22.

In reply to a circular, the following types of mills were entered for the tests :

- a) Mills with top rotation : mills composed of horizontal grindstones of which the upper one revolves.
- b) Mills with bottom rotation ; composed of horizontal grindstones of which the lower revolves.
- c) Vertical mills : mills with vertical grindstones, one of which revolves.
- d) Mills with vertical steel disks one of which revolves.
- e) Roller-mills with corrugated cylinders.

All the mills were tested in the machine department of the Agricultural College under the best conditions. Since it was necessary, before testing the work of the machines, to know the degree of milling usually adopted in the industry, ground samples were collected from various parts of the country for comparison. To ascertain the degree of milling, at least 3 sieves with respectively 2 — 1 — 0.5 mm meshes were used. If the meal passing through the 5 mm sieve was reckoned, 4 grades were obtained. All the mills were tested with maize, barley and oats, and the same degree of fineness was aimed at in each case, for only by this means was it possible to compare the efficiency and energy consumption of the various machines ; therefore model samples of maize, barley and oats were prepared. In the case of maize, it was decided that only 37 % of the material ground should be less than 1 mm in diameter ; this sample was a little finer than the average of those taken as the latter were considered too coarse. Only 31 % of the milled barley and 60 % of oats were to exceed 1 mm. in diameter. In judging the results however, a limit of error of 3 % was allowed in either direction as compared with the model sample. All the mills were worked by a 10 H P. continuous current engine. The power used by each mill was estimated as follows. The kilowatt-hours of energy consumed by the engine in the different trials were ascertained ; the watt-consumption was calculated on the basis of the length of the test, then, the energy directly consumed by the mill was calculated from the resistance curve. The relation gives the consumption of energy in kilowatt-hours per 100 kg. of material ground.

In all the mills with grindstones, the latter were made of artificial stone, the composition being a trade-secret of the various firms. This secrecy however, extends only to the mixture and fineness of the constituents of which the most important are magnesite, magnesite and fire-clay. Owing to the short time the tests lasted, it was not possible to decide which stone was the best and which system of mounting was to be preferred, but it is known that the mounting has a great effect upon the energy consumption, as well as upon the rapidity of the milling and the

amount of material ground. Since on a farm it is necessary to use the same mill for grinding various kinds of cereals to different degrees of fineness, the mounting selected must answer all requirements. The report gives examples of various systems of mounting. The following information has been taken from the "General observations" of this report

a) *Mills with revolving upper-grindstone* (8 of these were tested) In the old type, the revolving grindstone was so heavy as to be able to grind the grain by the effect of its own weight. Some of the new type of mills tested had such a thin, light revolving grindstone that its weight alone was not sufficient to crush the corn, and a spring arrangement underneath was provided, to press the revolving grindstone against the lower grindstone. Mills of this kind are lighter than those of the ordinary type and work regularly and silently, but although the pressure of the spring can gradually be relaxed as the resistance to be overcome decreases, these mills are not so simple as the old type in which the revolving stone grinds by means of its own weight

b) *Mills with revolving lower grindstone* (8 of these were tested). When equal in size, these mills give a larger output than the preceding kind. They work regularly and without noise but, as in the case of mills with revolving upper grindstone having a horizontal bar fixed to the pole, the pivot of the revolving stone must turn round within a hinged support. The millstone bridge is not as simple as that of the old type and probably this new type of mill will prove less durable than the original one

c) *Mills with vertical grindstones* (6 were tested). These machines are frequently well designed, they take up little room and their output is large. Naturally, the grindstones wear more than those of the larger mills, for they have to do the same work over a smaller surface, but they are easily mounted, so that most farmers could change the stones, and a new stone costs little. Since the construction of these mills is slightly more complicated, they will probably not last as long as ordinary mills with revolving upper grindstone

d) *Mills with vertical stone disks* (3 were tested) (These are very primitive and their chief merit is their low price. In all the machines exhibited the disks were mounted obliquely, therefore when worn, they cannot be reversed, or replaced. In the milling test, this type of mill turned out a coarser barley meal than the model sample, but the maize and oats could be milled sufficiently fine.

If the material is ground twice, the meal is quite satisfactory

e) *Roller-Mills* (3 were tested) When well-made these mills are excellent and work more cheaply than those with grindstones. As however, their construction is more complicated than that of the stone-mills, their duration is shorter and they need more careful handling.

All the mills were able to grind maize, barley and oats. Mills with grindstones, or vertical disks, do not grind the oleaginous seeds of lupins well, as they crush them into paste instead of meal. Roller-mills can deal also with lupin-seeds (although with difficulty) if the cylinders are revolved rapidly.

The description given of the tests is very exact and exhaustive ; and the report is illustrated with diagrams showing nearly all the apparatus and their grindstones (in order to demonstrate their mounting). In some cases the construction, millstones and working are described in detail. A summary of the results of the experimental tests and the opinion of the expert is given for each machine. The following is a specimen form.

"Element". Horizontal, revolving lower grindstone of artificial cement, 500 mm. in diameter. Brødrene, Larsen, Assa.

Speed at periphery 9.6 m. per second. Power required when running light 0.24 H.P.

No of test	Cereal milled	Amount ground per hour.	Consumption of energy		Current used to grind 100 kg by means of the 80 % electro- motor	Tem- perature of the machine	Degree of Fineness				Dif- ference as com- pared with standard sample + finer — coarser
			average	per % kg. of cereals			above 2 mm	from 1 — 2 mm	from 0.5 — 1 mm	below 0.5 mm.	
	kg.	H. P.	H. P. hours	H. P. hours	Kilowatt hours	°C	%	%	%	%	
1	Maize	644	8.2	1.27	1 171	19	4	20	33	43	+ 13
2	"	644	7.2	1.12	1 020	17	6	25	32	37	+ 6
3	"	672	7.3	1.09	1.000	16	7	30	29	34	0
4	"	672	7.0	1.04	0 958	16	8	33	28	31	4
5	Barley	360	7.3	2.03	1 865	21	2	19	40	39	+ 10
6	"	472	8.0	1.69	1.559	19	2	30	38	30	1
7	Oats	392	7.5	1.91	1.750	25	35	25	19	20	— 1
8	"	392	7.3	1.86	1.713	25	35	28	18	19	— 3

The numbers in heavy type give the results of tests in which the milling was as fine as in the standard sample. There alone must be considered in comparing the energy used by the different mills.

The experts' opinion. The mill which is entirely of iron is extremely well made. When supplied with clean grain, its work is certain and regular ; in the case of barley or other cereals with husks, the mill grinds less regularly. The lower millstone is very securely fixed. The hinged support of the pole is solidly fastened both as regards the foot and the pivotted neck, as it is strengthened by cast-iron blocks and a supporting-plate also of cast-iron. A convenient feature is the possibility of removing the cloth that forms the hood, without displacing the lower grindstone.

The amount of current used in grinding 100 kg of cereals exceeds the average of the tested mills with grindstones by 7.3 H.P. and 12 watts for maize ; 8 H.P. and 34 watts for barley and 7.5 H.P. and 310 watts for oats.

The mill grinds 372 kg. of maize per hour with 7.3 H.P. ; 472 of barley with 8 H.P. and 3.92 kg. of oats with 7.5 H.P. The sacks are easily changed owing to the mill having two apertures both provided with

rings for strong straps which do not injure the sacks. The mill is an excellent one ; and thoroughly well constructed, and is adapted for an engine of 7-8 H.P.

Some experiments were made to show the effect on the energy consumption : 1) of the amount of material ground , 2) of the fineness of the milling ; 3) the perimetric speed

1) The experiments conducted with a mill carrying a vertical stone of cement showed (what was afterwards confirmed by tests made with other types of mill) that the machine worked with the greatest economy e.g. with minimum power consumption for a given charge, if the charge consisted of 275 kg of maize an hour

2) Three series of experiments were made with different types of mill having respectively a revolving upper grindstone ; a revolving lower grindstone ; a vertical grindstone. It would have been very useful to have been able to learn from the tests how much power was required for a percentage increase in the fineness of the milling, this is not shown by the table of results, from which it is seen that this relation is not constant, but varies with the kind of cereal and the mounting and size of the grindstones, as well as with the perimetric speed. The figures do however, show that the consumption of energy rapidly rises with the increased fineness of the milling

3) Some experiments were made with two mills, one carrying an upper revolving grindstone and the other a lower revolving grindstone. The peripheral velocity was regulated according to the speed necessary for milling oats, since a little greater, or less, degree of velocity is not so important in the case of either maize or barley (*Corr Denmark*).

472 Chopped Rice Straw as a Feed for Cattle.

FARCHETTI, A. *Il Giornale di Risicoltura*, Vol. XII, No. 10 pp 155-175, 1 fig, No. 11, pp 173-176, 1 fig, No. 12, pp 185-187. Vercelli, 1922

The advantages of using chopped green food (especially when fibrous) in feeding cattle are generally recognized. Accurate figures, however, are not available for determining the necessary degree of fineness in relation to the type of crop and of animal to be fed, the proportion in which chopped should be mixed with ordinary feeds ; the manner in which it should be fed etc

Rice straw fed alone to cattle is not, generally, acceptable, on account of the excess of silica contained, it is perhaps also indigestible and consequently injurious, but mixed with concentrates and more nutrient feeds, such as dregs of pressed grapes, whey, hay, mangolds, potatoes, rape, etc. it becomes, owing to its power of absorption, an excellent feed, better assimilable by the digestive organs than concentrates alone, and therefore more acceptable. At the present time a great deal of this straw is wasted where rice is grown and the author refers to machines made by A. SQUASSI, which make rice straw chopping an inexpensive process and its use as forage consequently profitable. These machines include 3 types (of 3 — 5 — 8 HP respectively) of disintegrators and 3 types (3 — 5 —

8 HP) of pulverisers. Each consists of a cylindrical case containing strong steel plates, against which the material to be chopped is forcibly driven by a revolving drum, co-axial with the case and fitted with the necessary points and hammers; between the plates are arranged, readily changeable metal gratings through which the chopped product is discharged. In the pulverisers the points are rigidly fixed on the rotating drum, in the disintegrators they are more loosely attached. F. D.

473. The Importance of the Type of Feed-Water for Boilers in Dairies.

A. F. Die Bedeutung des Kesselspeisenassers für Molkereien. *Molkerei-Zeitung*, Year 37, No 1, pp 1-2 Hildesheim, 1923

In every case, care must be exercised that the boiler is not rapidly destroyed by the water supplying it.

River water contains a larger or smaller percentage of mechanically transported material; after filtration the water is excellent for supplying boilers, since it contains few substances in solution, or at all events, many fewer than are present in subterranean water.

While the substances mechanically mixed with water are comparatively easily removed, it is much more difficult to get rid of those in solution.

The most important salts forming such deposits are:— Magnesium carbonate; calcium carbonate; magnesium sulphate; calcium sulphate.

Different waters vary greatly as to the presence and amount of these salts to which their hardness is due; 1 degree of hardness (German scale) corresponds to 1 gm. of calcium and 0.7 gm. magnesium in 100 litres of water.

The size of the boiler is a very important factor in determining the water that can be used; for a boiler of large capacity, the feed-water may have 10 degrees of hardness, but if the boiler is small the water must be softened, even if its hardness is only 6-7 degrees. The calcium carbonate and magnesium carbonate separate out during the process of boiling and form a deposit. Temporary hardness can be removed by heating the water to 80°-100° C. and adding at the same time some caustic lime, or caustic soda; 1 kg. of calcium must be added per 1000 litres of water.

Sulphate of lime and sulphate of magnesium can be removed as a deposit by boiling the water and adding some calcined soda in the proportion of 1.9 gm. the every 100 litres of water to be softened. Care should, however, be taken not to introduce too large a quantity as this immediately induces the formation of froth. It is very advisable to add a soda solution until a faint blue coloration is produced on litmus paper. The litmus-paper test should be applied every day.

Condensed water is also very suitable, as its heat can be utilised again and it is free from all deposit-forming, or encrusting matter, care must, however, be taken to see that it does not contain any oil, which is very injurious to boilers; as a precaution, this water should be passed through a Koks filter, or through wood wool E. P.

BIBLIOGRAPHICAL NOTE.

474. WESTRA, J. G. Uitkomsten van een rooiproef in het Djatibeheerscomplex Gedangan (Java) in 1921-1922 *Tectona*, Part XV, No. 12, pp. 1111-1116. Buitenzorg December 1922

Results with a new stump puller in the teak forest district Gedangan (Java) in 1921-1922. D. V. S

AGRICULTURAL INDUSTRIES

Plant products

- 475 "Moskonfyt" Syrup from Pure Grape Juice.

VAN NIEKER, S. W. (Government Viticulturist) *Journal of the Department of Agriculture, Union of South Africa*, Vol VI, No 4, pp 315-319 Pretoria, April 1923

A summary of the manner in which moskonfyt syrup is made on the farm in South Africa. Must from grapes pressed the same day is extracted from the skins, collected in a tub and allowed to settle and next morning transferred to a copper or iron pot and boiled. The scum formed is removed and the must continuously stirred. After boiling for about 3-4 hours the moskonfyt syrup is obtained. Preference is given to boiling in an open pot and the taste is also improved by adding fig leaves, cinnamon, etc.

Certain questions with reference to the sugar concentration have recently received attention as a result of the increase in production of moskonfyt on a commercial scale. Details are given of experiments made at Elsenburg Viticultural Station, and it is concluded that from 68-69% sugar gives the most satisfactory results. This corresponds to a boiling point of about 108 C. It has been proved that it is necessary to reduce acidity of the must to about 3-4.0 % before concentration, and a 75 % pure calcium carbonate is advised in preference to slaked lime, which imparts a bitter taste to the syrup. The custom of leaving the must to ferment slightly before boiling has been investigated. Crystallisation takes place more slowly, but the fermentation has probably a beneficial effect; further experiments will, however, be made.

The growing importance of this industry is now fully recognised.

M. L. V.

476. Co-operative Grain Storehouses (Dock-Silos) in North Africa.

FURCHER, H Les magasins à blé coopératifs dans l'Afrique du Nord *Revue agricole de l'Afrique du Nord*. Year 21 No, 183, pp. 69-74 Algiers 1923.

In most of the cereal-growing districts of North Africa, the agriculturist has no store-houses for his grain, and the farms which are generally 25, 50, or even 100 km. distant from the railway, only possess inferior means of transport and bad roads that are impassable during winter. Therefore, he is obliged, in order to avoid risk of loss and to be able to realise in good time the sums he needs for the following agricultural season, to clear off and sell his crop as soon as it is harvested and before the cart-tracks and roads at his disposal become useless.

In this way, all the products of the same district are thrown on the market at once, so that the farmer is unable to safe-guard his interests at the time of sale, the clearing-stations are obstructed and the cereal-growers consequently suffer serious injury.

The only remedy for this unsatisfactory situation is the construction of co-operative wheat "docks", or store-houses, in all centres which have no means of housing or disposing of their grain. These store-houses would enable the producer to send away his crops as soon as they are carried, at which time (August, September) he has at his disposal every means of transport. Further, he could raise money on his grain in order to obtain the sums he requires and have the cereals sold when he considers the market most favourable.

These advantages did not escape the notice of the South African farmer, who as long ago as 1918, realised that the storing and clearing of his crops was of paramount importance.

We must not forget in this connection that after the harvest of 1918, many hundreds of thousands of quintals of wheat remained exposed to the winter storms as a result of lack of housing-room and means of transport, and were finally removed at great cost on the backs of thousands of dromedaries brought especially for the purpose from the south, where they had already been distributed, after spending the summer in the North.

As a result of these misfortunes, it was strongly urged that large store-houses should be constructed in Algeria, especially on the great grain-growing plain of Sersou, on the High Plateaux (average altitude 800 metres), where over one million quintals of wheat are annually produced.

This granary, which will have a capacity of 125 000 hectolitres (about 100 000 quintals of wheat) was begun in 1922 and will be finished in time to house the harvest of 1923. Like the American elevators, it is divided into two parts, the one intended for storing the grain consists of 100 silos each with a capacity of 1250 hectolitres, a side measurement of 2.50 m. and a height of 20 m. and the other part is specially arranged for the reception and storing of the grain, and houses the necessary machinery.

Reception - The grain is brought by the producer either in sacks, or loose, and after threshing it is weighed, poured into a hopper, raised to the sorter (3rd floor) where it is all cleaned; on leaving the dresser, the weight of the clean seed is registered by an automatic weighing ma-

chine, the specific gravity of the grain is determined and the offal placed at the disposal of the consigner.

The grain is then raised to the upper transporter and poured into the right silo ; it is stored loose, according to its quality which is estimated from the specific gravity.

Delivery. — The silos open at the bottom and discharge their contents on to a transporter that carries the grain to the receiving hopper ; this grain is raised by an elevator to the bagger, put into sacks (on 1st floor) and graded. As the railway and high road are just below, the trucks, or lorries, can be loaded with the minimum amount of labour.

Standardisation. — The quality and specific gravity of the grain in each silo being known, it is easy, by regulating the opening of the various silos, to obtain a homogeneous mixture composed of grain of the same type, and uniform specific gravity which allows of standardisation being effected. In this manner large quantities of grain of uniform specific gravity will be able to be put on the market at once which will facilitate direct dealings with the flour mills, allow of better prices being obtained and tend to the suppression of middlemen. On the other hand, the Society of the Co-operative Granaries at Sersou which considers that the peasant should not speculate, arranges for the stored grain to be sold monthly in fractions of $\frac{1}{4}$, $\frac{1}{5}$ or $\frac{1}{6}$ during the 4, 5, or 6 months following the harvest. The money obtained is then divided according to the quantity and quality on consignment of the grain deposited by each farmer, all of the consigners thus profiting by the prices paid during the whole season.

Until these sales are effected, the agriculturist who finds himself short of money can obtain, on the security of his grain, any sums he may need which are readily advanced to him by the Banks of Mutual Agricultural Credit, or other Banking establishments.

The above are the chief regulations for the working of these storehouses. The capital necessary for their construction which has been fixed at 1 250 000 fr. (10 fr. per hectolitre stored) has been obtained as follows : 500 000 fr. paid immediately by the cooperative members (5 fr. per hectolitre of grain stored) 500 000 fr. from the grant made by the Colony and 250 000 fr. also from the Colony in the form of a long term loan.

The large sum which the Colony has thus placed at the disposal of the Co-operative storehouse-silos of Sersou shows the importance attributed by the Algerian Government to the formation of this Co-operative Society. We may consider that but for this assistance, the first storehouse with elevator would not yet have been built. For the construction of those to be built in future, if the budget permits, the Algerian Government intends as a general rule to pay one quarter of its contribution in the form of a grant and one half in the shape of a loan.

With such encouragement, there is no doubt that other similar storehouses will soon be built. So far, in addition to the Burdeau storehouse, another with a capacity of 10 000 quintals has been constructed at Brazza (Algiers) owing to the initiative and perseverance of M. RÔGER. Further storehouses, at Thiersville (50 000 quintals), Maalifs (25 000 quintals)

Bel-Abbès (100 000 quintals), Relizane (100 000 quintals) and Inkermann (40 000 quintals) are under consideration, or are shortly to be built.

The " Société des Docks-silos coopératifs du Sersou ", after making a careful study of the different storehouses for grain used in various countries, have come to the conclusion that the German " Kornhauser ", though adapted to countries with small holdings, are not suitable for the storage of the large quantities of cereals grown on the High Plateaux of Algeria. It has therefore decided, to make the first grain storehouse of the type of the American elevator and provided with the latest and most improved apparatus for cleaning and sorting the grain

E. P.

477 Characteristics of Italian Grape Pips.

L'industria degli oli e dei grassi, Caratteristiche dei vinaccioli italiani Year III, No 2, p 16 Milan, 1923

As a result of the work of the a Cattedre Ambulanti di Agricoltura. (Itinerant Agricultural Instruction) the " R Stazione sperimentale Oli e Grassi di Milano " has collected 22 samples of grape pips from practically every part of Northern and Central Italy. Analyses have been made to ascertain the oil content (extracted by solvent or expressed) and the iodine value. The pips, air-dried, contain on an average 28.7% moisture and 33 % impurity. The oil content of crushed pips extracted with ethyl alcohol varied from 8.52 % to 17.52 %, average 14.4 %. There is also a marked difference in the yield including that of two samples from the Province of Modena. Two samples from Cagliari gave respectively 14.28 % and 12.65 %. The iodine value varied between 94 and 118 the amount of oil obtained by pressure was invariably somewhat lower than that obtained by solvent extraction

F. D.

478 The Constituents of some Indian Essential Oils.

SIMONSEN, J. L. and RAU, M. G. *Indian Forest Records*, Vol IX, Pt IV, p 36 Calcutta, 1922

Results of a series of investigations with reference to the economic value of certain essential oils. Hitherto only the constants of the oils have been determined and no attempt made to isolate the actual constituents present.

The following oils were subjected to thorough examination —

1) Oleo-resin of *Pinus Khasya*: yield 60 % crude rosin per maund (1 maund = 82 lb), 16 gall turpentine per maund.

2) Oleo-resin of *Pinus Excelsa* yield 68 % crude resin; 25 gall., turpentine

A comparison is made with the yield of rosin % in crude resin of *P. longifolia* viz 70 %.

3) Essential Oil from *Cedrus Deodara* Loudon: the experiments seem to indicate that the commercial value of this oil is limited and that probably it would be more remunerative to distil the logs themselves and to use the crude wood oil as a timber preservative.

4) From *Andropogon Jawarancusa* Jones; comparative experiments with the oil from *Cymbopogon Sennarensis* Chiov from the Soudan seem to indicate their identity. The oil contains 45 % ketones (chiefly peperitone)

5) From seeds of *Zanthoxylum alatum*, Roxb. *T. Budrunga* Wall, and *Z. acanthopodium* D. C. — The two first appear to be of little commercial value. The last, however possesses a high linalol content and is of undoubted economic value. M. L. Y.

479 Studies on Hemp Retting.

ROSSI, G. *Annali della R Scuola Superiore d'Agricoltura in Portici*, Vol. XVII Portici, Della Torre, 1922

Reference is made to several recent improvements in the methods employed for hemp retting and to new applications on a wide scale of practical importance. The following facts should be noted

1) it is unnecessary to allow the current of air to continue for the entire period of retting as with flax, as 10 to 24 hours is sufficient.

2) the retting water can be utilised again with advantage (to the extent of $\frac{1}{3}$ old to $\frac{2}{3}$ new), adding the new culture to the constituents of the maceration,

3) it is probably advisable to separate the retted material by washing both for hemp and for flax;

4) sulpho-carbonic solution can be recommended for retting with aerobic pectic ferments, in a current of air

In connection with this point, a description is given of several experiments made in 1920 in the Fünfkirche (Pecs, Baranya, S. Hungary) well-known for the Harkany springs, which are a source of carbon oxysulphide and are utilised in the hydro-therapeutic establishment on the premises. The carbon oxysulphide (COS) is uncommon and often confused with sulphuretted hydrogen (H_2S). Its origin is shown by the formula



This solution is conducted to Drawazaboles (in the immediate neighbourhood of Drava) where it is used by the *Harkany* factory for the maceration of hemp which has been transported by the river

Retting is carried out in 8 large tanks placed inside a closed hangar; into which the current of warm water is directed. Under normal condition retting with Drava water commences at a temperature of 35° C. but later the temperature falls according to surrounding conditions. Drying is carried out in the neighbouring fields near Decauville.

Nothing exceptional was noted when examined microscopically.

Two experiments were made which should be of practical commercial value; the first dealt with 100 qx. of unretted stems; the second with 150 qx. of flax straw. These were first mixed with Harkany water, brought to the required temperature and then after about 2 hours, the water was aerated, causing the greater part of the CO_2 and the COS to escape, 20 litres of culture *B. Comesii* were used.

Retting for unstripped stems requires 42 hours and for stripped hemp 60 hours, as note must be taken of the external low temperatures (which may fall to -5°C) with a consequent lowering of the temperature of the reservoir to 31°C in the first case and to 28°C in the second experiment.

The continuous washing of the material as practised in the establishment in question, gives excellent results.

The present studies include observations on the physiology and habits of the aerobic pectic microbe. The author claims, as a result of 20 years research that it may be concluded that a variability in type exists, but that it is possible to identify the old stock as *B. Comesii*, *B. krameri* and *B. pecticus* and to distinguish them from other types isolated.

A descriptive comparison is made between 13 types, distinguished during 13 years' study, and the author confirms the hypothesis put forward in 1907 that *B. Comesii* includes a number of species. Mutations have occurred and an illustrated description of experiments is given, which indicate that the zymogens vary in activity with different cultures made under similar conditions.

After alluding to the resemblance which exists between other microbes the author considers that the pectic ferments may be applied also to *Asclepias* spp., *Sportium junceum* and to *Urtica* spp. but not to *Humulus Lupulus*.

G R

480 Cold Storage as an Aid to the Marketing of Plums.

OVERHOLSER, E. L. *College of Agriculture Agricultural Experiment Station Berkeley, California, Bulletin No. 351*, pp. 427-463, tables 8 Berkeley, 1922

The plum has not been regarded hitherto as a cold storage fruit. The investigations recently undertaken indicate, however, that certain varieties of California plums can be held in storage for 6-12 weeks and will retain their good dessert condition for some time.

The factors involved in the ripening of fruit are discussed. Records have been made of the respiration numbers (*i. e.* amount of carbon dioxide evolved by unit weight in a unit time), of several fruits, and this represents a measure of the rapidity of ripening. According to this the plum can be kept in cold storage for comparatively long periods of time.

Trials made at the Experiment Station, Berkeley, indicate that the most desirable temperature for storage appears to be 32°F , especially with late ripening varieties. For short storage, however, a temperature of 36°F has no marked influence; this point is of interest in shipping (*e. g.* varieties Kelsey, Wickson, French, Grand Duke and Satsuma kept for 5 weeks and were marketable 7-10 days later).

Observations made as to the degree of maturity for picking fruit for storage show that frequently shipping plums are picked too green. Fruit from the third picking made 4-10 days after the second proved better quality on ripening than from the first and second pickings, and stored with equally good results.

References to market prices indicate that storage of early plums is not profitable although this does not apply to mid-season and late varie-

ties. Of the varieties tested the Kelsey, Grand Duke and Wickson kept longest and proved the most satisfactory. The author includes tabulated data for cold storage of 23 different varieties at 32° F (3 year's observation).

Attention is drawn to the precautions necessary in picking, grading, picking and handling fruit and reasons for failure in storage.

M L Y

481 **The Freezing Temperatures of some Fruit, Vegetables and Cut Flowers.**

079 WRIGHT R C and TAYLOR G F (Office of Horticultural and Pomological Investigations Bureau of Plant Industry) *United States Department of Agriculture Bulletin* No 1133 pp 1-8 Washington D C 1923

Determinations of the freezing points of a number of fruit and vegetables have been made by the Bureau of Plant Industry in compliance with the ever increasing demand of trade and shipping.

Determinations were made as follows:

1) Apples. Average 28.48° F,

2) Bananas (green) peel 29.84° pulp 30.22°, ripe peel 29.36° pulp 20.60° blackberries 29.15°, cherries 27.81°, cranberries 26.70°, currants 30.21°, gro. cherries 28.91°, grapefruit 28.36°, grapes 28.16°, loganberries 29.51°, oranges 28.03°, peaches 29.4°, pears (hard-ripe) 28.46° soft ripe 27.83°, persimmons 28.33°, plums 28.53°, raspberries 30.41°, straw berries 29.93° F.

Vegetables. Average for beans (snap) 29.74° cabbage 31.18° carrots 29.57° cauliflower 30.08° egg plant 30.41° Kohlrabi 30.02° lettuce 31.2° onions (dry) 30.09°, peas (green) 30.03° pot toe 28.92° sweet corn 28.95° sweet potato 28.44°, turnips 30.23° F.

Cut flowers. Petals and leaves of lilies peonies and roses from 27° to 31° F.

M L Y

Animal Products

482 **The Use of Morphological Phenomena in Research on the Watering of milk.**

SPIRILICI L (Head Physician of the Saint Spiridon Hospitals, at Jassy, Rumania) Phenomenes morphologiques dans les liquides organiques. Application a la constatation du mouillage du lait. *Bulletin de la Societe Scientifique d'hygiene alimentaire et d'Alimentation rationnelle de l'homme* Vol X, No 10, pp 632-638 figs 6 Paris, 1922

The author has devised a new method to detect the watering of milk. The system is based on the facts that every organic liquid, according to its origin, exists under special physico-chemical conditions and that its morphological aspect, which is only the visible expression of these conditions, varies with the change taking place in them.

The indicator he used for the detection of added water in milk was a solution made by mixing about 23 drops of horse, or human, serum with

[481-489]

a drop of good, liquid Chinese ink. A series of large drops of milk are dropped upon a sheet of glass, and one drop of the liquid indicator is placed in the centre of each. As soon as the indicator comes into contact with the milk, it takes on a different appearance according to the composition of the milk, thus enabling certain changes in the milk to be recognised. When the milk is skimmed, but not watered, the indicator floats on the surface of the drop; if the milk is adulterated by the addition of one-fourth of water, the indicator sinks into the drop, only leaving upon its surface a light trace of colour. In the first case, the reaction is said to be positive, while in the second, it is negative. The reaction of unadulterated skim milk whether it has been boiled, or not, is always positive, whereas watered skim milk before and after boiling, and pure boiled, or unboiled, unskimmed milk has a negative reaction. Therefore if milk is to be tested by the new method, the following system must be adopted. If the reaction is distinctly positive, it may be concluded that the milk is unadulterated, but has been skimmed; if, however, the reaction proves negative, a small quantity of the milk is centrifugated; a positive reaction obtained from this skimmed milk would show that it had not been watered, but a negative reaction would prove the milk to have been adulterated. Should the milk examined after centrifugation not give a distinctly negative reaction, this would prove the amount of water added to be below 25 %. If the reaction is uncertain, $\frac{1}{8}$ of water has been added to the milk sample, if the reaction then becomes distinctly negative, it can be safely assumed that the milk had been watered, if, however, the reaction still remains slightly positive, the milk tested was certainly quite pure. To be profitable, 25 % or even more of water must be added to the milk.

Watered milk to which starch, or sodium bicarbonate, has been added to mask the watering always has a negative reaction.

Milk that has been watered and then evaporated until all the added water is removed, and the serum of milk that has been completely skimmed after the casein has been separated by means of an acid, give a positive reaction. The author also studied the effect of the season, of the breed of cow, and the daily milk yield upon the morphological phenomena and found that they had no influence on the result. Many variations due to the origin of the milk are observable but these are of no importance.

It remains still to be determined how far the morphological characters vary with the proportion of water, casein, albumen, lactose and salts present, and to find the exact limits of the reaction when water has been added to the milk.

F. S.

483 Determination of the Specific Gravity of Fresh Milk.

BARKE, S (Chimiste en chef des Usines Nestlé), and HONIGGER, P. *Le Lait*, Year 3, No. 1, pp 3-10 Lyon, 1923

The authors point out that the fixing of the specific gravity of milk has up to the present been arbitrary and that this weight can be affected

by causes other than age and temperature; for example, by transport conditions which can diminish the specific gravity of milk.

To restore the milk to its original specific gravity it must be placed in a bath of boiling water and gently stirred until it has reached the temperature of 40° C; the milk is then rapidly brought back to a temperature of 15° C and the specific gravity is determined.

The experiments have proved that this method is sufficient for all kinds of milk at all stages and whatever the temperature at which they have been preserved.

F. S.

484 Estimation of the solid Fat-Free Substances in Cows Milk.

MASUROVSKY, B. (Dairy Husbandry Department, University of Lincoln, Nebraska), A Study of the determination of solids-not-fat in Cow's Milk. *Journal of Dairy Science*, Vol VI, No. 2, pp 145-149, table 1, figs 1, bibliography Baltimore, 1923.

The variability coefficients of the fat free solid matter content of cows' milk as determined by the Babcock formula are as follows: Jerseys: 0.9925; Holstein-Friesians: 0.9917; Ayrshires: 0.9955, Shorthorns: 0.9890; mixture of the milk of all these breeds: 0.9922.

On comparing the results obtained by the Babcock formula with those obtained by the gravimetric system, the author found an average deviation of 0.0604 in the case of the Babcock system.

The formula should therefore be corrected and stand thus:

$$\text{Solids not-fat} = \left(\frac{L}{4} + 0.2 f \right) 0.0604.$$

F. S.

485 The Uses and Synonyms of "Thionin".

CONN, H J (Department of Bacteriology, New York Experiment Station, Geneva, New York) Thionin. *Journal of Dairy Science*, Vol VI, No 3, pp 135-136, Baltimore 1923

There are two kinds of thionin, one simply thionin (synonym Hauth's violet), and the other thionin blue. The former is used in the FROST method for counting and studying the bacteria in milk, while the latter, which is not suitable for these purposes, is the best known, being employed in dyeing. (Schultz's Farbstofftabellen).

F. S.

486 Injurious Action of Light on Butter.

LAUTHERWALD, F. Die Schädliche Einfluss des Lichtes auf die Qualität der Butter. *Molkereizeitung*, Year 37, No. 17, p 309. Hildesheim, 1923.

Basing his remarks on personal experience in the capacity of "Molkerei-instruktor" (Instructor to the Dairy and Dairy Products Industry), the author lays stress on the strong action of light upon butter which is far more injurious than is stated by treatises on the subject, or believed by practical dairymen. Ten minutes exposure to brilliant sunshine is enough

to give a sebaceous appearance and flavour to the finest sample of butter. He therefore advises the following technique :— the butter must be worked as soon as it comes from the churn, salted, made up, and at once taken into the dairy (which must be dark, damp and well-ventilated) ; there it should be left to drip until the next day, again made up, put into barrels and the covers put on. The windows of the butter dairy must be red, yellow, or grey. The custom of exposing butter for sale in the shop-window should be abandoned, even if it is covered over to keep it dark. Also in the house, the butter should be kept in yellow, red, or grey glass vessels and never in green, blue or colourless receptacles F. D.

487 **The Air Content of Butter.**

RAHN, O and STORN, A. Die Luftgehalt der Butter *Molkerei Zeitung*, Year 37, No 23, p 433 Hildesheim, 1923

A high air content diminishes the keeping qualities and the delicacy of flavour of butter as the result of oxidation phenomena, the development of aerobic bacteria, etc. The authors determined the amount of air present in numerous samples of butter by means of an apparatus of their own invention. In the specimens shown at the Butter Exhibition held in 1922, in Schleswig Holstein, they found field-made butter to contain on an average 4.42 cc of air per 100 gm (max 7.20 cc., min 1.74 cc, while the figures obtained per 100 gm of dairy-made butter were respectively 4.14, 4.50 and 0.97 cc. In the case of 17 samples of butter sent to the Hamburg Butter Auktionen (sales by auction), the average maximum and minimum amount of air in 100 gm of butter was 2.83-3.60 and 1.34 cc. The two series of results therefore agree fairly well. It is thus clear that the air content of different butters varies considerably, in the product of some farms it is particularly high, but generally speaking, field-made butter contains more air than dairy-made. F. D.

488 **Effect of Oil of Mustard upon the Coagulating Power of Rennet.**

DRUGÉ, M. F. (Expert chimiste, chimiste en chef de la maison Lefèvre-Utile, de Nantes) Influence de l'essence de moutarde sur le pouvoir coagulant de la présure *Le Lait*, Year 2, No 10, pp 808-809 Lyons, 1922

In order to determine the effect of mustard oil upon the coagulating power of rennet, DRUGÉ compared the time required for the coagulation of a control lot (milk and rennet) with the length of the coagulation process in the case of other lots to which mustard oil had been added in different proportions and under various conditions. These experiments showed that mustard oil has no effect whatever on the coagulating property of rennet. R. D.

489. **Honey and Atmospheric Moisture.**

WATERS, R. (Biological Laboratory Wellington), *The New Zealand Journal of Agriculture*, Vol XXVI, No 2, pp 106-107. Wellington, 1923.

From the results of laboratory experiments the author concludes that in a dry atmosphere, the water content of honey rises with its increase in

specific gravity, whereas a lower specific gravity allows the water to escape more easily. On the other hand, when the atmosphere is saturated with moisture, honey with a higher specific gravity is able to absorb relatively more water in a given time than honey with a low specific gravity. In a saturated atmosphere, the samples used by the author were able to absorb water much more rapidly than they could yield it up in a dry atmosphere.

The author found on exposing honey to natural atmospheric conditions, but protecting it from the sun, that it slowly reaches a state of equilibrium as regards gain and loss of water, after which its moisture content varies with the change in atmospheric moisture but in a lesser degree. These variations would, however, seem to be more perceptible as the temperature of the atmosphere rises.

By exposing the honey to the air only during the hours of sunshine, the author proved that the quality of honey depends upon temperature. In fact, at a temperature of 10° C to 15° C the specific gravity of a good honey decreases by 0.001 in 2 or 3 days, whereas when the temperature is from 15° to 26° C, the specific gravity of a honey of poor quality increases 0.001 every 8 or 9 hours.

F. S.

BIBLIOGRAPHICAL NOTES.

- 490 SCHMITTHENNER, F. Wein Entkeimung auf kaltem Wege durch Filtration 1. In: Neues Verfahren zur Behandlung krankheitsgefährdeter Weine (Freeing Wine from Microorganisms by Filtration) *Wein und Rebe*, Year 5, Part 1, pp 3-12, figs 2 Mentz, 1923

Description of the F-K multiple disk-filter made by Messrs. SEITZ of Kreuznach (Rhine Province). This filter has pores less than 1 micron diameter and is able to free wine completely from all micro-organisms without the application of heat, or any alteration in the bouquet of the wine, which must, however, be clarified previously.

F. D.

491. CIFERRI, R. Risultati ottenuti in esperienze di relazione fra la fermentazione vinaria e i protozoi del terreno (Correlation between Grape fermentation and Soil Protozoa) *Rivista di Ampelografia*, Year IV, No. 1, pp 4-5 Alba, 1923

Observations were made concerning : 1) the relation between protozoa found in the grape, 2) the subsequent effect on the rate of fermentation. It was noted amongst other things that the small proportion of Protozoa existing in the grape (independent of the variety. in the clean, healthy and uppermost grapes) are identical with soil protozoa and they in no way hinder or alter the fermentation process.

F. D.

- 492 WILSON, C. A. Exploitation of Nipah Palm in Malay, as a Sugar and Alcohol Source *Sugar*, Vol. 25, No 3, p. 130 New York, 1923.

Report of the new projects for the cultivation of Nipah palm, primarily for its alcohol producing qualities, and a comparison of the treat-

ments given in the manufacture of sugar in other countries. According to reliable statistics nipah supplies the cheapest alcohol known. M. L. V.

- 493 EATON, B. J and DENNETT, J. H Report on Investigations on the Production of Alcohol from Nipah Palms (1) *The Malayan Agricultural Journal*, Vol XI, No 3, pp. 47-63, tables 4. Kuala Lumpur, 1923.

The authors supply information concerning areas reserved for Nipah palm in the Federated Malay States, followed by a report of investigations on: 1) Composition of sap, and changes which occur during and after collection; 2) methods of planting; 3) yields of sap and period of tapping 4) production of alcohol and sugar. M. L. V.

494. WOODMAN, H E, (Animal Nutrition Institute School of Agriculture, Cambridge University) The Chemistry of the Strength of Wheat Flour. *Journal of Agricultural Science*, Vol XIII, No 3, pp 231-243, bibliography Cambridge, 1922

Investigations by comparative methods, of the gliadine and glutenine proteins from typical strong and weak flours. It is suggested that the strong wheat synthesises one type of glutenine and the weak wheat a different type, whilst wheats of intermediate strength may contain varying proportions of the two glutenines. L. V.

- 495 Dr HANS GEILLINGER, D Experimentelle Beiträge zur Microbiologie der Getreidemöhle *Travaux de Chimie alimentaire et d'hygiène Publiés par le Service fédéral (Suisse) de l'hygiène publique*, Vol XIV, Pts 1-2, p 17 and Pt 3, p. 115 Berne, 1923

Research on *Coli* bacteria in wheat flour.

D. V. S

496. LIPPMAUN, Dr E C Fortschritte der Rubenzucker Industrie, 1922 *Chemiker Zeitung*, Year 47, No 13, pp 89-91 Gothen, 1923.

An account of the sugar beet industry in Germany, from the agricultural, technical and chemical standpoints D. V. S.

497. PERIN, L. (ingénieur chimiste) Extraction de l'huile des graines oléagineuses par l'acétone (Extraction of Oil from Oleaginous Seeds by means of Acetone). *L'Industrie chimique*, Year X, No 109, pp. 64-65, fig 1. Paris, 1923

- 498 SIMONSEN, J L, and MADYAR GOPAL, RAU. (Forest Research Institute, Dehra Dun) The Constituents of Indian Turpentine from *Pinus longifolia*, Roxb *Journal of the Chemical Society*, Vol 123-124, No. 725, pp. 549-560 London, 1923 (see also 1920, 117 p. 570)

D. O. S.

(1) See R. Jan.-March 1923, No. 112. (Ed.)

- 499 ALLEN, W. J. Storage of Lemons, *The Agricultural Gazette of New South Wales*, Vol. XXXIV, Pt 2, p 127. Sydney, 1923.

Results of comparative tests with stored fruit: 1) dusted with slaked lime, 2) coated with vaseline; 3) dusted with sulphur; 4) wrapped without treatment. The Experiments were made at the Yanco Experiment Farm and at Hawkesbury Agricultural College. The liming treatment proved the most effective.

M. L. Y.

500. VIERA NOVO, A. As amendoas *Broteria, Serie de Vulgarização Científica*, Vol III, Part I, pp 10-16. Braga, 1923.

This article contains an account of almond growing and trade in the chief countries of production, and especially in Spain. Some information is also given respecting almond production in Portugal. The principal centre of this industry in the latter country is the Province of Algarve. In 1919, 784 459 kg. of unshelled almonds and 1 526 627 kg of shelled almonds were exported from Portugal, as against 779 790 and 1 502 048 respectively in 1913. In years of greater production when the export trade is more active, almonds fetch higher prices.

F. D.

501. LECENDRE, G. Le contrôle laitier et beurrier au pâturage en Normandie. Milk and Butter Tests made in the Pasture Districts of Normandy. *Revue de Zootechnie*, Year 2, No. 1, pp. 65-72, figs. 3. Paris, 1923.

After having described the constitution of the Milk Testing Associations that have been formed in the districts of Caux and of Bray the author passes on to give an account of the work of the controller and the method of calculating the milk and butter production of cows subjected to these tests. The article also contains a reproduction of one of the certificates presented to the breeder for each of his tested cows at the end of every lactation period. It should be noticed that in the district of Caux, milk testing is not only carried out in the cowshed, but also in the pasture.

F. S.

502. MACY, H. (Dairy Bacteriology Laboratory University of Minnesota, St Paul, Minnesota). A Ropy Milk Organism isolated from the Finnish "Puma" or "Puli". *Journal of Dairy Science*, Vol VI, No. 2, pp. 127-130. Baltimore, 1923.

Description of a Finnish ropy-milk organism to which the author has given the name of *Streptococcus piima*.

F. S.

503. POZZI-ESCOR (Institut National d'Agriculture et de médecine vétérinaire, Idma, Peru). Procédé de numération rapide des éléments microbiens du lait, applicable au contrôle industriel. *Annales de Chimie Analytique et de Chimie appliquée*, Series 2, Vol. 5, No. 5, pp. 130-132. Paris, 1923.

Rapid method for counting of microbes in milk, applicable to commercial control.

D. V. S.

504. BOUSKA, F. W (Superintendent of Manufacturing, Beatrice Creamery Company, Illinois) Acidity of Butter and its By-products *Journal of Dairy Science*, Vol VI, No 2, pp 112-226, figs 2 Baltimore, 1923

Practical hints for churning and for regulating the acidity of butter
F. S

- 505 RHOADS, E (Assistant Chief, Poultry Division, Live Stock Branch) Canadian Egg Standards *The Agricultural Gazette of Canada*, Vol X, No 1, pp 28-30 Ottawa, 1923

Canada is at present the only country where egg-classification is based on external and internal characters The eggs are graded according to weight, size of the air-space, transparency of the yolk, consistency of the white, and cleanliness The author sets out the different rules for the classification of exported and imported eggs, and describes the manner in which egg marking is controlled
F S

- 506 BALAVOINE, P Sur la multirotation des miels *Travaux de chimie alimentaire et d'hygiène, publiés par le Service fédéral Suisse de l'hygiène publique*, Vol XIV, Pt 3, p 125 Berne, 1923

Studies on the determination of the polarimetric value of natural honey.
D. V S

PLANT DISEASES

Plant parasites.

- 507 Potato "Scab" (*Spongospora subterranea*) Reported in Algeria.

CHRSTIAN, J Une nouvelle maladie des tubercules de pomme de terre en Algérie *Revue Agricole de l'Afrique du Nord*, Year 21, No 197, pp 993-995, fig 1; No 198, pp 310-312, figs 2, No 199, pp 330-332 Algiers, 1923

The presence of potato "scab" (*Spongospora subterranea*) has lately been discovered in Algeria.

Two hypotheses, both equally plausible, have been advanced to explain the origin of the disease in this Colony, viz., either favourable conditions have caused the myxomycete, which already existed in Algeria as a saprophyte, to become parasitic and to attack potatoes, or else, the pathogenetic agent has been introduced by means of imported tubers possibly of British origin.

The author does not believe that the "scab" will do any great harm to the Algerian crops. The yield of two fields of infected potatoes in the neighbourhood of Algiers, one at Guyotville, and the other at Fort-de-l'Eau, was relatively little reduced. At Guyotville, 60 kg. of potatoes were lost out of 22 quintals of tubers lifted, while at Fort-de-l'Eau, out of a crop of 660 kg., only 60 kg. were spoiled. In the first case, the loss amounted to $\frac{1}{10}$ and in the second to about $\frac{1}{38}$. These crops had been obtained from tubers of foreign origin (var Royal Kidney) planted in December.

The external and internal symptoms of the disease are described by the author, as well as the factors favourable to its development and the means of control.

G. T.

508. Observations on the "Stripe Disease".

PAINE, S. G. and MACEY, M. S. *The Annals of Applied Biology*, Vol. IX, Nos 3-4 p 2p10-212 London 1923

The question has already been raised as to whether on further investigation, the "Grand Rapids Disease" might not prove to have a common etiology with the Stripe disease (1). Two organisms have been isolated from the "Grand Rapids Disease", viz. *Bacillus lathyræ* and the yellow *Aplanobacter michiganense* E. F. Smith, which possess many properties in common. Recent investigations and inoculations have shown that the two diseases are quite distinct, and the yellow organism, *Aplanobacter simulans* n. sp. which is frequently found associated with *Bacillus lathyræ* is not identical with *Aplanobacter michiganense*.

G. B. T.

509 *Fusarium* sp. *Colletotrichum phomoides*, *Phytophthora infestans* und *Tetranychus telarius* on the Tomato in Argentina.

GIROLA, C. D. Enfermedades del tomate en Argentina. Podredumbre apical (*Fusarium* sp.), Antracnosis (*Colletotrichum phomoides* Sacc) y peronospora (*Phytophthora infestans* De Bary). *Boletín del Ministerio de Agricultura de la Nación*, Vol XXVII, No 3, pp 503-504, figs 1, Buenos Ayres, 1922.

In February 1922, the fruits of tomato plants growing at Temperley F. C. S. were found to be suffering from two diseases "podredumbre apical" (apical rot, a malady never before reported from Argentina, but which the author is inclined to attribute to a species of *Fusarium*), and "anthracnosis" (*Colletotrichum phomoides* (Sacc) Ches.). The leaves of the same plants also showed traces of "peronospora" (*Phytophthora infestans* De Bary), a fungus not hitherto observed on the tomato in the Republic, and of the presence of a mite, *Tetranychus telarius* L.

The author considers the simultaneous presence of these different parasites to be due to the prevalence of meteorological conditions that were specially favourable to their development.

Apical rot seems fairly diffused, for the author found *Fusarium* present on tomatoes coming from very distant places.

(1) See R. 1920, No. 700 (Ed.)

The most effective means of controlling the disease is to use only seed from healthy fruits selected from plants that have remained immune. Further, tomatoes should never be planted on soil that has been contaminated for several years. It is well to spray the plants with ordinary Bordeaux mixture; the treatment should be applied soon after the tomatoes are transplanted and must be repeated three or four times before the fruits begin to form. This prevents the appearance of "peronospora" and "anthracnosis" which predispose the tomatoes to apical rot.

All parts of the plant showing any trace of the disease ought at once to be cut off and burnt. It is a good plan to disinfect the sticks supporting diseased plants with a $\frac{1}{1000}$ solution of corrosive sublimate, or with formalin.

G. T.

510 Apple Canker (*Nectria galligena*) Infection through Scab Wounds.

WILTSHIRE, S. P. (University of Bristol Agricultural and Horticultural Research Station, Long Ashton) *Annals of Applied Biology*, Vol. IX, Nos. 3-4, pp. 275-281, tables 1. London, 1922.

The author has referred in a previous paper to the fact that the canker fungus (*Nectria galligena* Bies.) can enter the apple tree through wounds caused by scab fungus *Venturia inaequalis*, and in this article describes this process in detail.

The scab fungus infects the shoots of apple trees during the autumn following their growth, in the spring most of the pustules are surrounded by a cork layer and are subsequently completely separated from the tree, the only trace of infection being a slight roughness of the bark, which facilitates the entry of the canker. If the tree is sufficiently vigorous to form a cork layer round such a scar before the wood has become infected, the canker makes very little progress, otherwise the fungus develops in the normal way.

A microscopic examination reveals the presence of two mycelia somewhat difficult to distinguish between, but generally speaking, that of the scab fungus appears dark and inclined to be thick walled, whilst that of the *Nectria* fungus is hyaline and thinner.

The penetration of *Nectria galligena* into the cortex is described in detail. During the summer the progress is slow, as was confirmed by observations.

As regards control measures, it seems that it is not only a question of protection of fruits, but also of the bark injured by the scab *Venturia*. Winter spraying, immediately after defoliation, has proved effective.

G. B. T.

Weeds and Parasitic Flowering Plants.

511 South African Species of *Cuscuta*.

YUNCKER, T. G. Revision of the South African Species of *Cuscuta*. *American Journal of Botany*, Vol. IX, No. 10, pp. 555-575, Vol. X, No. 1, pp. 1-17, tables 5, bibliography. Lancaster Pa. 1922-1923.

In a recent study, the author made an examination of a number of specimens of *Cuscuta* from South America, and has since made a thorough

revision, based on the examination of a several collections in herbariums in various parts of the United States. This article includes a description and key to the species known to occur in South America and the Galapagos Islands, comprising 38 species, seven of which are new to science viz. — *C. brevisquamata* (Argentina), *C. argentinana* (Argentina), *C. boliviana* (Bolivia), *C. goyaziana* (Brazil), *C. serrata* (Brazil); *C. orbiculata* (Brazil), *C. insquamata* (Bolivia).

For all the species mentioned, the distribution in South America is indicated and reference is also made in this monograph to the North-American species. The host plants are not given. G B T.

Animal parasites.

512 **New Coleoptera Injurious to Different Plants in India and Brazil.**

BRYANT G E. New Injurious Phytophaga from India and Brazil *Bulletin of Entomological Research*, Vol XIII, Part 3, pp 261-265, figs 4 London, 1923

This paper gives a description of the following beetles

1) *Bromodius squamosus* n sp. (fam *Eumolpidae*), collected at Simla (India), where it was found attacking the young leaves of pear-trees in an orchard.

2) *Brevicolaspis villosa* n sp (fam *Eumolpidae*), found in Bahia (S Brazil), where it attacks the coco-palm;

3) *Metachroma rosae* n sp (fam *Eumolpidae*), collected from rose-tree leaves, at Manchester (Jamaica),

4) *Zomba gosypii* n. g and n sp. (fam *Halticidae*), collected at Luchenza (Nyasaland), and at Livingstone (N W. Rhodesia), where it injures the cotton-plant, the new genus *Zomba* belongs to the sub-family *Monoplatinae* and is closely related to the genus *Glenidion* Clark, of South America G B. T.

513 ***Chrysomphalus paulistus* and *Chrys. dictyospermi*, Coccidae injurious to various plants, observed for the first time in Uruguay.**

TRUSILLO, PEIUFFO, A. Dos nuevos coccidos para el Uruguay. *Chrysomphalus paulistus* Hemp *Chrys dictyospermi* Morg *República Oriental del Uruguay, Ministerio de Industrias, Defensa Agrícola, Boletín Mensual*, Year III, No 4, pp 48-50 figs 6 Montevideo, 1922

Leaves of *Ligustrum japonicum* and of *Prunus cerasus* examined in March 1922 in the Laboratory "Defensa Agrícola" at Montevideo, were found to be attacked respectively by *Chrysomphalus paulistus* Hemp. and by "bianca rossa degli agrumi" (*Chrys. dictyospermi* Morg.), new Coccidae to Uruguay.

Chrys paulistus has since been observed on leaves of *Laurus nobilis* and *Chrys dictyospermi* on leaves of *Kentia*.

Hitherto the only species of *Chrysomphalus* reported in Uruguay was *Chrys. aonidium* L. as a parasite on leaves and fruit of *Citrus* spp. This is

widespread in Montevideo and will do much damage if control measures are not adopted.

A brief description is given of the chief characteristics of *Chrys. paulistus* and of *Chrys. dictyospermi*. G. T.

514 **The " Argentine Ant " (*Iridomyrmex humilis*) Reported in the Territory of Valencia (Spain) (1)**

FONT DE MORA, R. Sobre la presencia de la hormiga argentina (*Iridomyrmex humilis* Mayr) en Valencia *Boletín de la Real Sociedad Española de Historia Natural*, Vol XXIII, No 2, pp 77-78 Madrid, 1923.

The " Argentine ant " (*Iridomyrmex humilis* Mayr.), which recently made its appearance on some orange-trees in the neighbourhood of Valencia, has already become very common in the orange-groves of Valencia itself and is not infrequently found in the gardens and nurseries.

According to observations made hitherto, the presence of the Formicide, encourages the propagation of the scale-insects (*Dactylopius citri* Risso), (*Pseudococcus citri* [Risso] Fern.), *Lecanum hesperidum* (L.) Burm *Saissetia oleae* (Bern), *L. oleae* (Bern) Walk.) and *Icerya purchasi* Mask. *I. humilis* does not, however, do any direct injury by attacking floral buds and flowers. The insect has even been found in some dwellings in the territory of Valencia

Satisfactory results in the control of the pest have been obtained by sprinkling the colonies with alcohol and benzine. Experiments are at present being made with arsenical mixtures, solutions of lysol and polysulphides of calcium.

Of the various formulae for preparing a viscous substance suitable for banding the trees to prevent the ascent of the ' Argentine ant,' the following have proved the best, although they are not entirely satisfactory —

1) Resin	2 kg
Castor oil	1500 litres
2) Tallow	0.5 kg
Fish-oil	1 litre
Powdered resin	1 kg

G. T.

515. **A Study of the Life-History of the Onion Fly (*Hylemyia antiqua*), in England.**

SMITH, K. M. *The Annals of Applied Biology*, Vol. IX, Nos. 3-4, pp. 173-183, 2 tables. London, 1922.

The Onion-fly (*Hylemyia antiqua* Meig — *Phorbia cepetorum* Meade etc.), has become very wide-spread of late years in some districts of England, and

(1) See R. 1922, No. 873. (Ed.)

especially in Lancashire and Cheshire, where it does considerable injury to the crops of onions, and to the trade in these vegetables.

The eggs of the onion-fly are white and 1 mm. in length, and very closely resemble the eggs of *Chortophila brassica*. They normally hatch in three days but if the temperature is not very favourable, the larvae sometimes do not emerge for 6 or 7 days. The grubs make their way through the soil and perforate the onion-bulb. When full-grown, they are 9-10 mm. long and 1 ½ mm. broad in the widest posterior portion. These larvae are white, their hind extremity is truncated and bears tubercles, while the anterior end is pointed and provided with two chitinous jaws. The larval period lasts from 18 to 27 days, the average being 20, in young onions, although it may be protracted for 4 to 5 weeks in old bulbs from the year before, that have been put into the ground to propagate themselves. The larval period of the later generations which do not hatch out until the onions are larger and more mature, is longer than that of the earlier generations.

On attaining its complete development, the larva leaves the onion and pupates in the soil but remains within a short distance from the bulb. It assumes a dark-brown colour and its length is reduced to 6-7 mm., although the larval structure remains fairly distinct. The nymph stage lasts, on an average, 17 days.

The adult insect somewhat resembles the house-fly, but is of a lighter grey. It is about 6 mm. long and bears thick bristles, arranged more or less in four longitudinal rows, on the thoracic region. The male and female insects are much alike, though the female is distinguished by having eyes wider-apart and a lighter colour, while the abdomen is broader and pointed at the distal end owing to the presence of the ovipositor. The author was not able to estimate exactly the duration of the life of the adult insect under natural conditions, in the laboratory, it varies from three weeks to two months. According to observations conducted in the field and in the laboratory, there are three generations in the year which make their appearance between the end of May and the beginning of October. The third generation usually passes the winter in a pupal condition.

Onions are the ordinary food of this fly, although it has occasionally been known to attack leeks and shallots, and is sometimes found even on tulips.

The injuries caused by the insect are especially serious in spring when the onion seedlings have just come up, frequently all the young plants are destroyed. If the onions have had time to develop, the plants grow yellow and turn black, while the bulb, which may harbour from 3 or 4 up to 25 or 30 of the *Hylemyia* larvae, becomes a semi-liquid, rotten mass.

The eggs are laid in groups of 6 to 30 on the leaf sheaths, occasionally, they are deposited on the ground. The most important parasites of the onion-fly are a braconid hymenopteron, *Aphacreta cephalotes*, and a Staphylinid coleopteron, *Aleochara bilineata*.

G. B. T.

516. An Attempt to Introduce Scoliid Hymenoptera from Madagascar into of Mauritius.

D EMMEREZ DE CHAIRMOY, D *Bulletin of Entomological Research*, Vol XII, part 3, pp 245-254, tables 4 London, 1923

The parasitism of hymenoptera of the genus *Scolia* on the larvae of large beetles (gen. *Oryctes*) was discovered as early as 1840-1841 in Italy by PASSERINI, and in 1854, in Madagascar, by CONQUEREL. More recently, L'ABRE discovered species of *Scolia* parasitic on *Cetonia* and *Anoxia*, while other similar cases have been recorded by different entomologists which show that the parasitism of these scoliids is generally not strictly specialised since the same species of hymenoptera may attack different species, or even genera, of host, while one host may harbour several species of these pests at the same time. This discovery is of practical importance, as it facilitates the introduction into any given country of foreign species of Scoliids in order to use them in the biological control of injurious Coleoptera

In 1916, an attempt was made to introduce from the Barbadoes into Mauritius, *Tiphia parallela* for the control of *Phytalus smithi*, but the experiment had to be given up on account of difficulties due to the War. In 1917, the author made an attempt to introduce into Mauritius from Madagascar, *Scolia oryctophaga*, the natural enemy of *Oryctes* *simier*, in order to see whether it would prove of great utility in the biological control of *O. tarandus* which is injurious to the sugar-cane crop.

In this account of his experiment, the author gives the results of his work in Madagascar between June and August which induced him to catch various species of Scoliids. He treats exhaustively of their greater, or less, diffusion according to the presence of certain plants which are favourites with the adult insect, and states that this preference could be utilised for the purpose of concentrating on a given area, large numbers of Scoliids and other insects.

The author then describes the method of transporting captured individuals of *S. oryctophaga*, and gives an account of the laboratory experiments which enabled him to determine that this species can be successfully used for parasiting *C. tarandus*. He also gives the biological observations he made, together with a detailed description of the various developmental stages of the parasite, and appends some observations respecting the other species of Scoliids found in Madagascar and Mauritius. He concludes by saying that although the experiment was not wholly satisfactory, its results did not prove entirely negative, so that it will be well to import more of these insects at the right season.

G. B. T.

517 *Tetrastichodes platanellus* n. sp. and *Coccidencyrtus poutiersi* n.sp. Hymenoptera parasites of the Microlepidopteron *Lithocolletis platani* and on Cochineal *Howardia zamiae* respectively in France.

GARCÍA MERCET, R. Calcidoideos nuevos de Francia. *Boletín de la Real*

Sociedad Española de Historia Natural Vol XXXII, No 9, pp 596-602
figs 4 Madrid, 1922

Description of two new species of Hymenoptera observed in Mentone (France) *Tetrastichodes platanellus*, parasitic on *Lithocolletis platanus* and *Coccidencyrthus poutersi* parasitic on *Howardia zamae* found on *Cycus revoluta*
G T

518 ***Phytodictus fumiferana* a New Hymenoptera Parasite of the Spruce Budworm *Tortrix fumiferana*, in British Columbia.**

ROHWER S A *The Canadian Entomologist* Vol LIV No 7 pp 155-156
Orillia 1922

Description of the Hymenopteron *Phytodictus fumiferana* n sp reared as a parasite of the Microlepidopteron *Tortrix fumiferana* Clemens ('spruce budworm'), collected in July 1919 at Lillooet, British Columbia
G T

519 **The Olive Fly (*Dacus oleae*) and its Parasites in Morocco.**

Communication officielle de la Direction générale de l'Agriculture du Commerce et de la Colonisation du Maroc à l'Institut international d'Agriculture

Investigations on the control of the olive fly (*Dacus oleae*) and its parasites made at the Laboratoire de Phytopathologie et d'Entomologie appliquée de l'Institut Scientifique Cherifien, these observations have already served a useful purpose in the olive districts of Marrakech

It appears that the eggs of *Dacus* are laid at varying periods. The *Opius concolor*, parasite of the olive fly has been found in Morocco and eggs have been obtained in the laboratory. It is not improbable that this valuable parasite develops normally in Morocco

Observations made by the Inspector of Agriculture at Marrakech seem to indicate that in this district the evolution of *Dacus* does not correspond with that reported in several other countries. The late appearance of the parasite, in mid-November and the rapid spread of the attack apparently excludes the possibility of successive generations during the summer

In addition to this, the beginning of the attack seems to coincide with the first rains and it has been noted that the attack is more virulent when the catch crops require a large amount of water. From the fruiting season until mid-December, the majority of larvae have left the fruit to burrow beneath the soil. This active larva, although sparsely equipped, ought to search for a shelter in which to pupate, but the soil in this area, when it has not been broken up, is extremely resistant to penetration by larvae, which are finally destroyed. The excessive heat of Marrakech during summer, may have a deleterious effect on the vitality of *Dacus*

It has been concluded that if these facts are subsequently confirmed, it should be possible to adopt certain cultural methods which will hinder the development of *Dacus*, limiting to a marked degree the damage caused by this parasite
G T,

520. **A Means of Freeing Fungus Cultures from Mites.**

JEWSON SIBYL, T and TATTERSFIELD, F. *The Annals of Applied Biology*, Vol IX, Nos 3-4, pp. 213-240, figs 3 London, 1922.

The infestation of pure fungus cultures by mites in bacteriological laboratories is the cause of such frequent and serious trouble, that it was worth while trying to find the best means of eliminating these intruders.

The authors' work at the Rothamsted Experiment Station has so far proved *Aleurobius farina* to be the commonest and most injurious species, although in some cultures, *Tyroglyphus longior* and *Glyciphagus cada-verum* are also present.

Experiments were carried out with different volatile organic compounds, ammonia, pyridine, aniline, monomethylaniline, dimethylaniline, benzene, toluene, naphthalene, paradichlorobenzene, carbon tetrachloride and carbon bisulphide, particular attention being given to the first two. Ammonia has a very rapid toxic action upon mites, but as the fungi also are affected, it cannot be employed for the elimination of acarids from the fungus cultures, although it is very useful in destroying the mites present in laboratory apparatus and Petri dishes etc. On the other hand, pyridine, whether pure or commercial, if applied in the right concentrations, kills the mites without perceptibly injuring the fungi which can be transplanted into new cultures that remain immune.

The authors give a minute description of the action of ammonia and pyridine upon both mites and fungi, and in conclusion, describe the best and simplest way to disinfect the cultures.

A soup-plate containing about 20 cc of commercial pyridine is covered with gauze and placed under a bell-jar having a capacity of about 20 litres. The test-tube of mite-infested cultures is placed, without removing the plug of cotton-wool, in the bell-jar, of which the mouth is closed with a sheet of glass fixed, with mastic or plasticine, and left there for 16 hours. If the infestation is very severe, the treatment must be prolonged for 40 hours, or repeated at intervals of 14-16 days to allow those eggs to hatch out that were not killed by the first treatment

G. B. T.

521 ***Pachynematus clitellus* and *Dolerus hæmatodis*, Leaf-Eating Sawflies on Cereals in Great Britain.**

ROEBUCK, A., *Bulletin of Entomological Research*, Vol. VIII, Pt 3, pp 267-269, figs 3 London, 1923.

Each season since 1918 numbers of leaf-feeding sawfly larvae, fam. Tenthredinidae have been seen in both oat and wheat crops, especially along the edges of the blades and on the upper portion of the leaves.

Two species have been identified as causing for the damage: *Pachynematus clitellus* Lep. and *Dolerus hæmatodis*, species of which have been recorded in America as attacking cereals. The larvae disappear from the fields during the latter half of July and pupate in the ground. The

emergence of the sawflies takes place in the laboratory or in the field during the first half of May.

Oviposition of the female *Dolerus* was found to be produced parthenogenetically, the eggs being deposited on the leaf margin in varying numbers, the maximum, 15 per leaf; the young larvae hatched after 3-4 days. No observations have been possible as regards oviposition of *Pach. clitellus* as the larvae died too quickly in the laboratory.

In addition to wheat and oats, other species of Gramineae, Juncaceae and Cariceae have been attacked. Although the damage is not serious, the author calls attention to the fact that this species has appeared regularly during five seasons in different fields in the Newport district.

G. B. T.

522 **Potato Moth (*Phthorimaea operculella*) in the Belgian Congo (1).**

GHEQUËRE, J. La teigne de la pomme de terre au Congo belge. *Annales de Gembloux*, Year 29, Pt. 2, pp. 38-43, tables 1. Brussels, 1923.

The potato moth (*Phthorimaea operculella* Zell), has been reported to have done considerable damage to the Solanaceae in Katanga and was introduced into the Belgian Congo with seed tubers coming from South Africa. Up till now the Microlepidopteron has not been observed in the other three provinces of the Congo nor in the surrounding foreign territory.

For several years the damage done passed unnoticed and was of minor importance but in 1919 the area attacked by potato moth was fairly extensive. In certain fields the losses were reported as 90% of the total yield and in some cases it was difficult to obtain healthy seed tubers; the losses have been noted earlier in the Upper Luapula territory.

The serious nature of the attack, the spread and the importance generally vary according to district, due largely to the Microlepidoptera as natural enemies. A Braconid has been reared by artificial means; the larvae which appears to be widespread, has been found living on the caterpillars and chrysalis of *Phth. operculella*, and the mite *Pediculoides ventricosus*, fairly common in the Congo.

A description is given of the different stages, with details as to habits and means of control found successful in combating this pest.

G. T.

523. **Mycetophilid Flies, Family *Sciaridae*, as Pests of the Cucumber Plant in Glass Houses in England.**

SPEYER, F. R., *Bulletin of Entomological Research*, Vol. XIII, Pt. 3, pp. 255. 259, figs. 8, tables 1. London, 1923.

In January 1922, serious damage to cucumber pot plants under glass in Enfield was reported and found to be caused by larvae of *Pnyxia* (*Epida pus*) *scabiei*, Hopk., minute flies belonging to the family Sciaridae, which feed on the roots. Similar cases were observed elsewhere.

(1) See R. 1922, nos. 331, and 351. (Ed.)

It is probable that the flies have been prevalent in glass houses in preceding years, but that the damage caused has been attributed to eelworm.

The plants examined were potted out from the seedboxes in the middle of December. Attacks were first noted on January 8th and within 5 days, 600 plants were destroyed. The tap root of the infected plants had been eaten by the larvae and hollowed out below the soil surface, some roots contained as many as 60 larvae. On no part of the plant were any eggs found as oviposition takes place only in the soil and apart from the root stem. The full-fed larvae ate their way out of the stem below ground and pupated after a few days.

Another similar species, namely *Plastosciara pernicioso*, has caused serious damage to cucumbers under glass in the Worthing district and at Dartford. The larvae reduce the tap root to pulp, and cause further damage by removing the cortex of the stem just below and sometimes even above the soil surface.

As regards control measures, the following chemicals have been used with a view to killing the larvae. potassium sulphide; ammonium carbonate + copper sulphate; mustard, calcium chloride; ammonium carbonate; nitric acid; hydrochloric acid; potassium bichromate; potassium permanganate; ammonia. Except hydrochloric acid, which is injurious to plants, none of these gave any appreciable result. During the experiments, however, it was found that the larvae are susceptible to moisture conditions and reproduction can to a certain extent be regulated by watering the soil. For example, larvae immersed in water were found to be dead in about an hour. To destroy the larvae in pot plants, immersion for 12 hours or well watering each day is a satisfactory control measure.

G. B. T.

524. *Araeceros fasciculatus*: Coleopteron injurious to Coffee in Colombia.

Un gorgulho que ataca os cafezaes *A Gazeta da Bolsa*, Year VI, No. 3, pp. 6-7. Rio de Janeiro, 1923.

According to the report of Prof. KOHLDOERF, received by the Brazilian Government, Ministry of Public Affairs, the coffee crop in Columbia has suffered from the attacks of the Coleopteron, *Araeceros fasciculatus* (1).

A brief description is given of this insect and its life history; treatment with heat and carbon bisulphide is considered effective, combined with thorough cleansing and repeated disinfection of the coffee stores where the Coleopteron has been previously observed.

G. T.

525. *Clastoptera theobromæ*, a Froghopper damaging Cacao in Panama.

WILLIAMS, C. B., *Bulletin of Entomological Research*, Vol XIII, Pt 3, pp. 271-274, figs. 3, tables 1. London, 1923

During a search for parasites of Cercopidae in Central America in 1916-17 the author observed a froghopper of the genus *Clastoptera* destroying

(1) See: *R* 1917, No. 1259 and *R*. 1918, No. 1438. (*Ed*)

the flowers of cacao in various localities in Panama. This is considered to be a new species, *Clastoptera theobromae* conspicuous for the masses of semiliquid froth which it leaves on the flower stalks of the cacao — each of these froth-masses contains from one to four or five nymphs, which suck the flower stalk and cause its death. Occasionally the froth occurs on other parts of the plant but never on the leaf petioles. In the froth the author found a number of larvae of a Drosophilid, thought to be uninjurious to the nymphs, but which probably are parasitic; observations made later on *Dros. paradoxa* found in the froth of *Clas. taeniata* in Trinidad support this hypothesis.

In addition to Panama, *Clas. theobromae* has been found in Costa Rica and seems also to exist in Ecuador

G. B. T

526. A New Phytophagous Chalcid attacking Bamboo (*Harmolita æquidens*).

WATERSTON, J *Bulletin of Entomological Research*, Vol VIII, Pt. 3, pp 307 310 figs 2 London, 1923

Description of the new species *Harmolita æquidens* which resembles the *Harm. phyllostachytis* described recently by A. B. GAHAN in California, but the new species was reared from larvae tunnelling in bamboo stems in Kuala Lumpur (Federated Malay States).

G. B. T.

527. *Papilio cornetii*, a Macrolepidopteron destructive to Fruit in New Caledonia.

PALADINI, F (Senior) La lutte méthodique contre les fléaux calédoniens. Un fléau dans le Nord de la Nouvelle-Calédonie Un papillon de nuit, destructeur de fruits (*Papilio cornetii*) *Revue agricole*, No 84, p. 10 Noumea, 1922.

A Macrolepidopteron called by the author *Papilio cornetii* — no description of the species being here given — does serious damage to all kinds of fruit in the north of New Caledonia where it has been known since 1876.

The insect only makes its appearance at the fruit-ripening season, viz., from November to the end of May, and can hardly be discovered during the rest of the year. It remains invisible all day on the fruit trees, but carries out its destructive work from nightfall until daybreak. The harm done by this parasite is greatest in seasons when the weather is especially mild and damp.

Once a fruit has been attacked by this Macrolepidopteron, it decomposes with surprising rapidity (in the course of one, or two, days). In 1922, similar to preceding years, the heavily-laden orange and mandarin trees were completely stripped of their fruit in two or three days as a result of the attacks of the parasite. The same may be said in the cases of peach and mango-trees, vines, *Nephelium Lit-chi*, etc.

According to one observer, the insect entirely devoured the pulp of a banana in a single night having found its way to the fruit through a hole in the sack.

There have been repeated cases of illness, one of which terminated fatally, amongst persons who have eaten fruit attacked by *Papilio cornetti*.
G. T.

528 Scale Insects injurious to Citrus Trees in Argentina.

BLANCHARD, E. E. Principales cochinillas de los citrus en Argentina. Primera parte: Coccidos protegidos *Boletín del Ministerio de Agricultura de la Nación*, Vol. XXVII, No 3, pp 387-398, fig, table Buenos Ayres, 1922.

Scale insects are some of the most destructive pests of the citrus trees in Argentina.

Firstly, the author deals solely with scale insects having their bodies protected by a shield. After a short account of their life-history, a description is given of the five chief species parasitic on citrus-trees in the Republic.

1) *Chrysomphalus dictyospermi* (Morg.) Leon ("cochinilla roja", "piojo rojo").

2) *Chrys. aonidium* (L.) popularly known as "cochinilla negra circular".

3) *Lepidosaphus beckii* (Newm.) popularly called "coma de los citrus" or "serpeta".

4) *Chionaspis citri* Comst. ("cochinilla blanca de los citrus").

5) *Aspidiotus hederæ* (Vall), generally known by the name of "cochinilla blanca del olivo".

Of the fungus parasites of the scale-insects, one representative of the gen. *Myriangium* is very common in the damp parts of Argentina.

The beetle, *Coccidophilus citricola* Brths occurs throughout nearly the whole Republic, it is one of the most formidable parasites of *L. beckii*. The hymenopteron, *Aspidiotiphagus citrinus* Hew, is a common endophagous parasite of *A. hederæ*.

The scale insects are also kept in check by various artificial means.
G. T.

BIBLIOGRAPHICAL NOTES.

529. FEYTAUD, J. Le Doryphore, Chrysomide nuisible à la pomme de terre (*Leptinotarsa decemlineata* Say). *Revue de Zoologie agricole et appliquée*, Year 21, No 8, pp 121-136, figs 7, No 8, pp 137-158, figs, 5, No 10, pp 153-166, figs. 1 Bordeaux, 1922

As a result of prevalence of the Colorado potato beetle (*Leptinotarsa decemlineata*) in the Gironde (France) (1) the author (Director of the Entomological Station at Bordeaux) has considered it important to bring before the public notice certain facts concerning this harmful American beetle.

(1) See R. 1922, No 897 (Ed.)

The subject is treated under the following headings: — Description of the beetle; life history; conditions favourable or otherwise to reproduction; distribution in America, in Europe, in the Gironde; means of control.

Legislative and Administrative Measures adopted in connection with this pest from 15 July, 1878 to 27 July, 1922 are included (pp. 150, 152, 166, 168 *Revue de Zoologie agricole et appliquée*) (1). G. T.

530. STOREY, G Recent Work on the Pink Bollworm *Cairo Scientific Journal*, Vol XI, No. 108, pp 15-20 Cairo, 1923

A brief review of recent information with regard to the Pink Bollworm; reference is made to the countries affected, alternative food plants, natural enemies and methods of control. G T.

(1) See R., 1922, No. 897. (Ed)

CURRENT NOTICES

Legislative and Administrative Measures.

Bavarian Law relating to the Examination of Stallions submitted for approval. (July 10, 1922) — No stallions can be licensed for public use that have not been approved by the examining commission ("Kor Ausschuss") of which the composition and work are regulated by the above law. The latter is accompanied by a decree dealing with 1) Breeding Stations, 2) the management of such Stations, 3) Stud Stations, 4) prizes for foals bred, 5) passing stallions, 6) stallions in service, 7) Breeders Associations, 8) Advisory Board for Horse Breeders (*International Institute of Agriculture, Bureau of Agricultural Legislation, Textes législatifs de l'année 1922*, No 34).

United States Law forbidding Operations in Grain Futures. (September 21, 1922) — In order to prevent speculation in the cereal trade between the various States of the Union, this law forbids the transmission by post, or, in trading between the several States, by telegraph, telephone, wireless telegraphy, or any other means, of communications dealing with the making, or confirming, of any contract for the purchase of grain futures, or giving information as to the state of the market and the prices quoted for such transactions (*Ibidem*, No 33).

Decree respecting the Control of the Colorado Beetle of Potatoes in France. — The *Journal officiel de la République française* (No 57 under date of February 27, 1923) has published the decree of February 13, 1923 which contains the regulations of the authorities for the application of the law of July 13, 1878, amended by the law of July 13, 1922, dealing with the measures to be adopted for the control of the Potato Colorado Beetle (*International Institute of Agriculture, Bureau of Agricultural Legislation, Textes législatifs de l'année 1923*, No 1. See also *R* 1923, p 250).

French Law relating to the Amendment of the Regulation applying to Distilleries. (February 2, 1923) — It deals with the notification of the substance distilled, taxes the distillation of alcohol in private houses, or in public establishments.

French Law referring to Stallions. (March 8, 1923). — Introduces amendments into the law of August 14, 1885 regarding the examination of stallions (*Journal d'Agriculture pratique*, April 14, 1923).

Decree for the Pomological Station of Caen (France). (March 20, 1923). — Gives the terms under which the Caen Pomological Station and of the Tours Departmental Laboratory are entrusted with the analysis of samples of beverages, food, and agricultural produce, and extends the mandates of the Municipal Laboratories of Rouen, Rennes and Mans (*Journal officiel de la République française*, March 24, 1923)

Law respecting Agricultural Taxes in France. (March 30, 1923). — This law fixes, for the year 1923, the maximum and minimum coefficients applicable, according to the crop, to the renting value of the land, to serve as a basis for the taxation of agricultural profits (*Journal d'Agriculture pratique*, June 9, 1923)

Order of the French Minister of Finance respecting the Exportation of Walnut Wood. (May 29, 1923) — An Order of March 11, 1922 had authorised the free exportation of walnut and oak wood whether squared, or sawn. The Order of May 29 introduces amendments as regards walnut-wood of which it prohibits the export (*Journal d'Agriculture pratique*, June 9, 1923)

Law for Renting the Alsatian Potash-Mines. — The French Chamber of Deputies has approved a bill dealing with the leasing of the potash mines in Alsace. The capital of the Society that has rented these mines is distributed between 6 groups, 50 % of the shares being reserved for the agriculturists as represented by their Associations. It has been decided with the consent of the Ministry of Agriculture, that the "Office national du Crédit agricole" shall have the prior right of acquiring (to the number determined by its Administrative Council) any shares that could not be subscribed for by the groups provided for by the constitution of the Society.

This Office may only dispose of any shares it acquires in favour of the whole agricultural group. The greatest precautions have also been taken to prevent the transference of the agricultural shares to any of the other groups. A sale-office shall be instituted of which the leasing Society and all the present, or future, managers of the potash mines must be members. This office shall have the exclusive right of selling in every country all the produce of the potash mines. The sale price in France shall not exceed the sale price in other countries unless special concessions are granted by the Higher Council of Agriculture, or the Higher Council of Mines (*L'Industrie chimique*, Year 10, No 110, pp. 114-115 Paris, 1923)

Official Documents Dealing with the French Colonies and Protectorates. Tunisia — Decree relating to the free admission of olive-oil, olive-pomace oil and potatoes of Tunisian origin (*Journal officiel de la République française*, February 9, 1923).

Morocco — Decree of the Grand Vizier instituting, for 1923, a prize for the encouragement of planting, or grafting, olive-trees and carob-trees, and setting forth the conditions under which the prize is to be awarded. (*Bulletin officiel du Maroc*, January 30, 1923)

Coast of French Somaliland — Decree rendering applicable to the coast of French Somaliland the law of March 1, 1888 regulating fishing in the territorial waters. (*Journal officiel de la République française*, February 17, 1923).

Cameroon — 1) Decree fixing the duty on tobacco exported from Cameroon. (*Ibidem*, February 4, 1923). 2) Decree organising and regulating

the testing of the kernels of the oil-palm before export from the territory. (*Journal officiel du Cameroun* March 1, 1923).

Togo. — 1) Decree of January 20, 1923 instituting, in Togo, the control of all cotton intended for export. — 2) Circular of January 21, 1923 relating to the inspection of cotton intended for export. — 3) Decree dealing with the protection of the palm in Togo; prohibiting the felling and export of timber trees for commercial and industrial purposes, and the carriage by rail of palm wine. (*Journal officiel du Togo*, February 1, 1923).

Island of Réunion. — Orders relating to the prohibition of export. The orders of April 5, 1914 and of April 14, 1920 relating to the prohibition of the export, or re-export, of agricultural products are abrogated. The exportation of: Mascati peas, "black peas" (*Mucuna* spp) and "mimosa" (used as a stock-feed) and the re-exportation of wheat flour and rice are still, however forbidden; (*Journal officiel de la Réunion*, January 26, 1923).

Madagascar. — The decree of March 8, 1923 approving of the agreement entered into between the Governor General of Madagascar and its dependencies and the Society for the Exploitation of Madagascar fibres, by virtue of which this Society has been granted the right to gather fibre plants on the different parts of the State property of the Colony. (*L'Agronomie coloniale*, No. 64, April 1923).

Order obliging dealers to declare their stock of rice and enforcing the declaration of all rice intended for export abroad. (*Journal officiel de Madagascar*, March 17, 1923).

Organisation of Locust Control in the Countries of Equatorial Africa, in 1922. — In 1922, came into force the Convention drawn up in Rome on October 31, 1920, between French West Africa, Algeria, Egypt, Morocco, Tripolitania and Tunisia for the organisation of the international control of Acrididi (an exception being however made as regards Egypt and Tripolitania).

The decision come to as regards the opening of a preliminary enquiry respecting the migrations of the "sauterelles pèlerines" (*Schistocerca galeana*), in the regions of Africa situated to the north of the equator has been carried out in these countries

The Governor of French West Africa has made a valuable contribution in the form of maps and documents giving information respecting the successive generations of the insects in these regions and showing the usual itinerary of the invaders. The necessary arrangements have been made and the organisation has now begun work. The swarms of locusts are reported, as soon as they are seen, the warning being given by telegram and by information forms; in this manner, the migrations can be followed every day.

The information collected in Algiers is regularly communicated to the States belonging to the Convention of the International Institute of Agriculture in Rome and maps of the dispersions of the swarms are drawn up and sent every month to the above States.

The good results obtained by this agreement will certainly show themselves before long (*Communication from the "Direction de l'Agriculture, du Commerce et de la Colonisation d'Algérie" at the International Institute of Agriculture*).

Importation of Live Plants and of Market-garden Produce from France into England and Wales. — Under the Colorado Beetle Order, dated December 15, 1922, which came into force on February 1, 1913, and was passed for the purpose of preventing the introduction of *Leptinotarsa decemlineata* Say, no live plants, or market-garden produce, from any French port may be imported into England, or Wales, without a special permit from an Agricultural Inspector, unless the said plants and produce be accompanied by a declaration from the grower, or cultivator, drawn up according to the form prescribed by the above-mentioned Order and stating that neither the live plants nor the market produce consigned have been grown in any of the following Departments of France: Gironde, Landes, Basses-Pyrénées, Hautes-Pyrénées, Haute-Garonne, Ariège, Aude, Gers, Tarn, Lot-et-Garonne, Tarn-et-Garonne, Aveyron, Lot, Dordogne, Corrèze, Cantal, Puy-de-Dôme, Creuse, Haute-Vienne, Charente, Charente-Inférieure, Indre, Vienne, Deux-Sèvres, Vendée, Loire-Inférieure, Maine-et-Loire, Indre-et-Loire and Lozère.

Law relating to the Export of Cattle into Great Britain. (December 1922). — Under the terms of this law (except in cases specially mentioned), it is permitted to import into Great Britain, Canadian breeding-cattle without their treatment, or slaughter, according to the provisions of the first part of the third appendix of the law of 1894 dealing with stock diseases. This law is provided with an appendix for the regulation of the trade in imported cattle (*International Institute of Agriculture, Bureau of Legislation, Textes législatifs de l'année 1922, No. 30*).

Legislative Measures concerning Butter and Cheese in Canada. — From April 1, 1923, all Canadian butter and cheese intended for export shall be classed according to its quality, further, every factory must put the number of the tub on each cheese, or box containing cheese, and the number of the churn on each case of butter. (*La Gazette agricole du Canada, Vol X, No. 2, p. 179 Ottawa, March-April, 1923*)

Law for the Encouragement of Agricultural and Rural Industries in Queensland (Australia). (August 15, 1923) — By means of this law, a Producers' Association has been founded under the name of the "Queensland Producers' Association", and with the powers, rights and obligations defined in the said law. (*Textes législatifs de l'année 1922, No. 31*).

Rabbit Nuisance Amendment Act. — Any person in possession of a license allowing him to destroy the rabbits on his property by means of traps is entitled to avail himself of this permission for a period of from 7 days to 3 months from the date of issue of the said licence, after which the use of traps for taking rabbits is forbidden without a special written permit. (*The New Zealand Journal of Agriculture, Vol XXV, No. 5, p. 315*)

The New Zealand Dairy Industry Amendment Act of 1922. — This Act regulates the analysis of the milk fat to be used in the manufacture of milk-products and requires the managers of milk-product factories to register the amount of milk consigned by each producer and the yield of the said milk in cream, butter and cheese: a copy of the registration form must be given to every supplier of dairy produce. (*Ibidem, p. 318*).

Law of the Republic of Haiti of December 1922, concerning Long Leases. — The Government is authorised to grant leases of State

land for periods ranging from 9 to 30 years. Such land can however, only be leased for undertakings that will materially contribute to the agricultural progress of the country.

Measures for the Control of Plant Diseases in Italy. — By means of the ministerial decree of March 24, 1923, published in the *Gazzetta Ufficiale* of the following 28 April, the provisions of the Ministerial Decree of September 28, 1919 may also be applied to the control of the vegetable and animal parasites of plants mentioned in Art. 8 of the Ministerial Decree dated February 21, 1921 (cfr. *International Institute of Agriculture, Monthly Bulletin of Agricultural Intelligence and Plant Diseases*, Year X, (1919) Nos. 10-12, Art. 1260; *Ibidem*, Year XII (1921), No. 4, Art. 443).

By means of another Ministerial Decree published in the above-named *Gazzetta Ufficiale*, the control of *Ips typographus* L. is compulsory in the centres where this parasite has been observed. The rules and methods for its control will be prescribed by the "R.R. Osservatori regionali di Fitopatologia" in conjunction with the "R.R. Ispezioni forestali". The superintendence of the operations and the official control measures to be carried out, in cases of omission or delay, shall devolve upon the Staff of the Royal Forestry Inspection Service.

By means of a Ministerial Decree under date of March 15, 1923 published in the *Gazzetta ufficiale del Regno d'Italia* (No. 116 of May 18, 1923) the black aphid of peach-tree roots (*Anuraphis persicae* Boyer var. *niger* Smith) (1) is included in the list of parasites of which the compulsory destruction can be ordered by the Ministry of Agriculture.

Measures passed in Holland between April 14 and November 8, 1922, introducing Amendments of the Law of 1918 dealing with Horse-Breeding. — These measures regulate the appointment of State Commissions for Passing Stallions, of Commissions for Inspecting Pedigree Books and of Provincial Stock-breeding Committees; they also define the powers of the said Commissions and Committees, regulate the compilation by Breed Societies of a public pedigree-book and establish the prizes to be awarded to horse-breeders and the conditions under which they are given.

Law passed in Holland for the Amendment of the Law concerning Higher Agricultural and Veterinary Instruction. (December 1922). — This law obliges all the Professors to reside in the Commune in which is situated the University where their lectures are given.

Law passed in Holland for the Control of Contagious Diseases of Poultry. (December 1922). — Regulates the importation and transport of Poultry.

Order passed in Holland on January 15, 16 and 17 and on March 12, 1923, deals with the Laws respecting accidents to agricultural and horticultural workers.

Order of the Ministry of Agriculture of Holland under Date of February 15, 1923 concerning the qualities required in seed wheat.

Portuguese Law of July 31, 1922 relating to Cereals. — Law No. 1294 to which are appended regulations concerning the valuation and

(1) See R. 1923, No. 156. (Ed.)

importation of wheat, milling, etc. (*Boletim da Associação central de agricultura portuguesa*, Year XXIV, Vol. 24, No. 9, 1922).

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Experiment Stations and Agricultural Instruction.

Agricultural Experiment Stations in Austria. — The work of these Stations is described in the Annual publication entitled *Zeitschrift für das Landwirtschaftliche Versuchswesen in Deutsch-Österreich*. The 1922 volume contains two articles, one written by O. RITMAR and giving an account of comparative manurial experiments made respectively with mineral phosphates and with "Reformphosphat" which the author considers to be equal in value to superphosphate, and the other by WERNECK-WILLINGRAIN, who treats of selection from the ecological standpoint.

School of Agricultural Mechanics at Mons (Belgium) — This school was founded in 1902 with the object of acquainting agriculturists with the most improved types of machines and teaching them how to handle, repair and keep them in order. This school was the first of the kind ever instituted either in Belgium, or elsewhere. In 1907, the School passed under the management of the Province which fitted it up with large plants. On November 4, 1920, the Provincial Council voted the credit necessary for opening a section for students learning to make agricultural machines. The workshop of this new section, which has an entirely modern equipment, started normal work on December 1, 1922, with a dozen students. The course of study and the apprenticeship last two and-a-half years. Pupil machine-drivers are not admitted under 16 years of age. They attend the courses and the repairs-workshop for 3 months and learn to drive and keep in order the machines by practical work in the open during the proper season. Particulars of the course and the regulations can be obtained from the "Direction de l'École de Mécanique agricole", 25 Boulevard des États-Unis, Mons, Belgique.

The Agricultural Station of Nyangwe, Belgian Congo, has been sold by order of the Crown to the "Compagnie cotonnière congolaise". Included in the sale are: one estate of 1000 hectares, buildings, and live-stock. (*Le Cultivateur belge*, March 10, 1923).

Canton Christian College. — Among the many branches of work engaged in by this College for the advancement of agriculture is that of the introduction of improved plants. One of the most valuable recent consignments was sent from the United States in February 1922. The citrus-tree collection of the College, which had before consisted solely of native species, was then enriched by the Washington Navel, Selecta, and Satsuma varieties of orange and by the Little River Grapefruit. Various citrus hybrids were also introduced with the object of testing them according to the system devised by the Office of Crop Physiology and Breeding Investigations of the Foreign Seed and Plant Introduction of the U. S. Department of Agriculture. A large collection of peach, almond, apricots and plums has also been acquired, together with a smaller number of pears, 6 species of pomegranates, specimens of *Carissa grandiflora*, *Macadamia termifolia*, *Acacia*, *Artocarpus Boehmeria*, *Cassia*, *Casuarina*, *Garcinia*, etc.

Secchum edule a common kitchen-garden plant of tropical America, and especially of Porto-Rico, has been introduced from California. It succeeded for a short time, but then died in spite of the rains of July and August. The pecan appears to do well in the Kwantung region. The College is continuing its acclimatisation work on a large number of arborescent plants from California, and on some specimens received from the Hawaii Agricultural Experiment Station. (*The Lingnaam Agricultural Review*, Canton Christian College, Vol. I, No. 1, Canton, December, 1922).

Seed Propagation Station at Zalla (Biscay, Spain). — The Zalla Station was founded in 1920. One quarter of its ground, viz., about 4 hectares is set apart for the improvement of agricultural plants, the rest being reserved for researches of local interest, such as the cultivation of various forage plants: Alexandrian clover, Hungarian moha (*Setaria italica* var. *germanica*), green Californian moha, early Caucasian moha, Etampes soy-bean, etc. Other plots are devoted to growing vines, including direct bearers, and to pasture. The following species cultivated in the district are being selected: wheat, maize, garden-beans, horse-beans, beets, potatoes, turnips and capsicums. The wheats studied come from ears gathered in the different zones of the Province, or from samples sent by the "ayuntamientos" (municipalities) of the Basque district, or from wheat cultivated at the Station of La Moncloa (Madrid) or imported (having been supplied by Messrs VILMORIN-ANDRIEUX of Paris). To this work must be added 936 "cengenarcas" of pure lines. Messrs EGUILEOR and ARZADUM are respectively the "jefe" and "ayudante" of the "Servicio agrícola" which controls the work of this Station. (*Estación central de ensayos de semillas. La Moncloa, Madrid, Boletín trimestral*, Year II, No. 7, pp 9-11, Madrid, 1922)

Popularisation of Agricultural Science in the United States. — The Ministry of Agriculture of the United States has published (*Circular* No. 253 February 1923) statistical data of the funds at disposal for the fiscal year 1922-23 for this propaganda work (Co-operative Extension Work) in which, during July 1922, 4387 persons were employed. In the 1922-23 budget, 18 821 000 dollars were allocated for this purpose, of which 5 880 000 dollars were furnished by the Federal Government (Smith-Lever Act) and the rest by the various States and local Public Bodies

Agricultural Experiment Station of Rhode Island State College, United States. — *Bulletin* No 190 of this Station deals with the assimilation powers of certain cereals and their susceptibility to fertilisers. By assimilation is understood the capacity of the plant to abstract from the soil the substances necessary to its existence without recourse being had to fertilisers. The bulletin gives the results of 10 years' experiments made in the field and in pots with the object of determining this capacity.

Agricultural Experiment Station of the University of Maryland. — *Bulletin* No. 249 of this Station contains a report of the Seed-control laboratory for 1921 during which year 460 samples were tested.

Agricultural Experiment Station of Wisconsin University Madison. — *Bulletin* No. 346 of this Station, entitled *Marketing by Co-operative Sales Companies*, treats of the co-operative sale of Wisconsin cheese by means of these Sale Companies. The cheese has been sold in this way

for 8 years by the Wisconsin Cheese Producers' Federation. The success obtained warrants the foundation of similar Companies for the sale of butter, tobacco, livestock and other agricultural products. The bulletin explains the special advantages of Co-operative Sale Companies and suggests a scheme for their formation.

Texas Agricultural Experiment Station. — *Bulletin* No. 298 of this Station bears the title of, "Commercial Fertilisers in 1921-1922", and treats of the State control of these manures; it also gives several tables of analyses of chemical fertilisers made in the various factories of Texas. *Bulletin* 300, "Organic Constituents of the Soil", deals with the nitrogen and organic substances present in soil. *Bulletin* No. 301 "Soils of Bell, Jefferson, Smith, Taylor and Well Countries", treats of the chemical composition, fertility and manurial requirements of the soils in these Provinces. *Bulletin* No 302, "The Needs of the Soils of Brazos and Jefferson Counties for Sulphur", discusses the sulphur content of these soils and the effect of sulphur manuring upon crops

Experiment Station for Citrus Growing at Riverside, California. — By means of pot cultures of barley, it has been proved that the productive power of a soil is not the same in the case of barley and of citrus-trees. The amount of nitrogen previously applied is no exact criterion of the capacity of a soil for barley production. In the soil used, phosphatic and potassic fertilisers had no effect upon either the barley, or the citrus crop. (*The Botanical Gazette*, Vol. 75, No 1, p 95, Chicago, 1923)

Soil Bacteriology at the Pasteur Institute in Paris. — A Section for soil bacteriology has been instituted at the Pasteur Institute in Paris and is entrusted to S WINOGRADSKY, formerly Director of the Institute of Experimental Medicine, in Petrograd.

Instruction in the Trade of Cooper in France. — At Auxerre, a school has been opened for coopers. The course begins in October and lasts 15 months. Students are not admitted under the age of 14. The course entails 48 hours of work weekly, 40 in the workshops and 8 devoted to general oral teaching. The casks made will be sold and the returns, after deduction of the cost of materials, will be divided into 3 parts giving respectively to the student, the teacher and the reserve fund

Agricultural Services and Experiment in French West Africa. — In the course of his report on the economic conditions of French West Africa, the Governor-General of the Colony described to the Council the experiments that had been made in the Niger Valley with a view to cotton-production. The cotton-growing company installed at Diré has obtained encouraging results on irrigated land and has been granted a concession of 2000 hectares. Other companies propose cultivating cotton without the help of irrigation. "The Association Cotonnière" is trying to get the natives to grow cotton on their land and promises its support and advice to all willing to make the attempt; this method has been adopted by the English with conspicuous success, on the Gold Coast, in the case of cacao production. In accordance with the provisions of the decree of August 16, 1922, the Government of French West Africa has founded several Experiment Stations of which those devoted to cotton-growing, the cultivation of the ground-nut and the oil-palm have

already begun useful work. (*Bulletin agricole de l'Algérie-Tunisie-Maroc*, Series 2, Year 29, No. 3, Algiers, 1923).

Agricultural Work in Dahomey, French West Africa. — The studies made in Dahomey have shown that a very large number of crops can be cultivated there. Many were already being grown with success viz., the oil-palm cocopalm, maize, cotton, tobacco, karité (*Butyrospermum Park*), kapok, indigo, manioc, yam, spp., rice, millet etc., while others have been imported with excellent results by the Agricultural Service. The latter plants include: indiarubber, cacao and coffee trees, kola, castor-oil, sisal, zapupe, filao (*Casuarina*), teak, *Cedrela odorata*, and various fruit and forest trees. The Stations of the Agricultural Service are fairly numerous in Dahomey, but have hitherto had only the character of Trial Stations. Henceforward they specialise in one of the most important crops. — 1) *Station for the coco-palm*. The most suitable area for the coco-palm is the strip of land along the coast which ought soon to be thickly planted with this valuable tree. The work of this Station is the formation of large nurseries of selected oil-palms. — 2) *Maize Station*. Maize is grown throughout the Colony but is most cultivated in the districts of Allada, Sakété and Pobé. The Sakété Station will be chosen as the centre for the study of maize. Some years, as much as 30 000 tons of this cereal have been exported from Dahomey, but this amount cannot be maintained, because the grain, although sound when on the plant, spoils very quickly. The object of the Station will not be so much to intensify maize cultivation, as to improve it and discover practical means of keeping the grain in good condition. It will also try and devise a mechanical shelling method. — 3) *Cacao and Coffee Station*. Both cacao and coffee have yielded excellent results, especially in the Allada and Mono districts. The Niaouli Station, which is the largest in Dahomey, will in future confine its attention to these two crops and will make extensive nurseries. — 4) *Cotton Station*. Cotton is grown in Middle and Upper Dahomey. Two Stations are to be established for this valuable crop, one at Abomey and the other at Savalon. The local varieties with hairy seeds have been improved by the introduction of other varieties with smooth seeds and fairly long lint. The chief work of the Station consists in choosing smooth seeds for distribution to cotton-growers at the sowing season. — 5) *Tobacco Station*. Tobacco is cultivated in the whole of Upper Dahomey the climate and soil of which are most suited to this plant. The Tobacco Station will be at Parakou and will occupy itself with the technique of tobacco cultivation. (*L'Agronomie coloniale*, Year 8, No. 61, pp. 24-27. Paris, 1923).

Station for the Selection of Oil Palms in Togo. — Owing to the agrological conditions of Lower Togo, the district of Tabligo-bo is the only part where a Station for the Selection of Oil Palms could be established. Here, on the basis of the small experimental Government plantation dating from the time of the German occupation, it will be possible to make a plantation of selected *Elaeis* trees supplied by the Dahomey Experiment Station, for with proper protection the young palms will do well. It seems only necessary to make one model plantation which is systematically managed. The laboratory will have to be started later, when the Station begins secondary selection and the regular distribution of selected trees to the planters. The

difficulties caused by the isolation and remote situation of Tabligo-bo will soon be removed when the railway is made, the only difficulty then remaining will be the water supply. The locality offers the advantages of a suitable climate and soil, natives used to growing oil-palms (although without direction), and the immediate proximity of a vast region to be gradually planted with oil-palms. (*Bulletin des matières grasses de l'Institut colonial de Marseilles*, No. 1, 1923)

Farm-Schools at Guelma, Algeria. — A farm-school attached to the Guelma Experiment Station will be inaugurated in November 1923, the management will be placed under the control of the General Government. It will take native pupils chosen as far as possible from among the sons of agricultural proprietors. The aim of the school is to give a sound, professional, agricultural education especially adapted to the crops and stock-breeding of the area in which it is situated.

The Foundation of a School of Applied Science at Hanoi, Indo-China. — An Order of the Governor-General has added to the Higher Schools forming the University of Indo-China, a new school of Applied Science. The task of this new school is to train experts for the Public Administrations of the Colony and for private chemical, electrical, or mining industries. There are 5 sections: Public Works — Industrial Chemistry — Electricity — Mining — and a higher course of Topography and Agricultural Valuation. (*Annales de l'Institut colonial de Bordeaux*, p 27, 1923).

The Development of Genetics Applied to Agriculture in Indo-China. — The necessity of improving the agricultural plants, and especially rice, in Indo-China was felt in the beginning of the French occupation. The many attempts which had begun as early as 1870, yielded scanty results, because genetics, as a science applied to agriculture had as yet no fixed principles and technique.

In 1913, the Governor of Indo-China decided to found a laboratory for rice selection at Saigon; this laboratory now forms part of the Service of Genetics treated for the purpose of extending in all the countries and to all the crops of Indo-China the work hitherto confined to rice in Cochinchina.

As regards rice, the first thing to be done is to determine and study the varieties supplying the best products for export and industry, without however neglecting the varieties intended for local consumption which often differ greatly from the other types. The amount of rice consumed locally is certainly not less than three million tons, the quantity exported being scarcely half as much.

A list of the varieties of rice capable of yielding good products must be compiled with due regard to agricultural conditions, the soil and climate being taken into account, since these factors greatly influence the productivity of the rice plant. In the laboratory of Saigon, 3000 individuals have so far been thoroughly examined and their germinative power as affected by the controlling factors is now being studied with the object of discovering any possible morphological, or physiological, correlations that may assist in the work of selection, etc.

Over 150 varieties have been introduced (from Japan, China, India,

Madagascar, Persia, Argentina etc.), in order to determine which of them can be acclimatised and used for further crossing.

The work of the central laboratory is completed by the "Seed Garden" ("Jardin de Semences") of Phu-my, and by the Cantho Rice-Growing Station with its four increase plots. This Station is already well-known to the rice-growers of the Far East. It now distributes at market prices the seed of the selected varieties, Hueki and Kamay. The amount of rice annually sold, which is only $\frac{1}{4}$ or $\frac{1}{5}$ the quantity required, already reached 60 tons, sufficient to sow 2500 hectares and produce a crop of about 600 tons.

The products of the first generation are sold separately for seed and find increasing favour among the agriculturists. The exporting firms value selected rice and offer a higher price for consignments accompanied by the form vouching for its authenticity given by the Service of Genetics.

The work of rice-selection has recently been extended to Tonkin, and is carried on at the Agricultural Sections of Tuyen-Quang and Phu-Thô (*La Vie technique et industrielle*, pp 17-19, Paris, 1923).

Seed Control in England in 1921-22. — The annual report of the Official Seed Testing Station for the year 1921-22 has been published recently by the National Institute of Agricultural Botany in its technical report for 1922. The above-mentioned report may be summarised as follows: The number of seed samples tested was 25 822, viz., about 2000 more than in any preceding year. In March 1922, 5185 samples were examined. The number of agriculturists making use of the Station was 35 % more than in the preceding year. There was a great increase in the number of cereal and red clover samples submitted and a decrease in the leguminous samples sent, while the numbers of samples of other species had not greatly changed. As was to be expected after the very dry summer of 1921, the quality of locally grown seeds was better than usual.

Cereals: The germinating power of barley and wheat will much exceed the average for previous years, while that of oats and rye is about the same as the average for previous years. A large increase was noticed in the number of wheat samples infected with rust or darnel, while the rye was less infected than usual by ergot.

Roots and Kitchen-Garden Plants — As a rule, the germinating power of the seeds was slightly above the average, but the quality of the seed samples of parsnips, carrots and onions was not as high as could be desired. The quality of the mangels and sugar beets was good.

Forage Leguminosae — The average germinating capacity of English red clover seed was 83.6 % as against 76.3 % in preceding years. The purity of the seed was greater. English white clover showed similar improvement, but to a lesser extent. The quality of the lupins was improved. The Czecho-Slovakian clover seeds that contained many impurities the two previous years, were much superior last year. The percentage of dodder present in all the forage leguminosae was a little higher than in the year before.

Forage Gramineae — It is somewhat difficult to compare the 1922 data for purity and germinating capacity with those of the preceding years, because the method of analysis has been entirely changed. The adoption of the system used on the European Continent has resulted in lower figures being

obtained for purity and higher ones for germination. It seems however, that the seeds of the rye-grasses were below the average, while those of the Phleum and Meadow Fescue seeds were up to the average. (*The Journal of the Ministry of Agriculture*, Vol XXX, No 1. London, 1923).

The West Indian (Trinidad) Agricultural College. — This was opened in October 16, 1922, and at the end of the first year, the progress made gave promise of its future success. In the next academic year, a 3 year course of tropical agriculture will be began; specially favourable terms will be made to students of other Universities, or Higher Schools, wishing to attend this course with a view to extending their knowledge of tropical agriculture, or to carry out experimental research under tropical conditions. The organisation of the technological sugar course is not yet completed, but a model sugar factory will soon be equipped (*Nature* No 2802, 1923).

Cotton Research and Teaching Institute in the Transvaal. — The Transvaal University proposes to found an Institute for cotton research to work in collaboration with the Department of Agriculture, Tobacco and Cotton Division. Amongst other questions studied there will be the control of the plant and animal parasites of cotton, the formation of standards, the length and tenacity of the lint, the spinning quality of South African Cotton, and the general development of the cotton industry. (*Journal of the Department of Agriculture, Union of South Africa*, Vol VI, No 2, 1923).

Royal Experiment Station at Reggio Calabria for the Industries of Citrus Essential Oils and Derivatives. — This Station was founded by Decree No 213 of the Lord Lieutenant under date of June 1918, and has recently started work. Its chief objects are to: carry out analyses and experiments at the request of the public and of the public Administrations; study questions concerning the production of citrus essential oils and derivatives; conduct experiments and promote the cultivation of plants for the perfume, unguent, soap and other industries, study the local flora in order to obtain perfume plants, acclimatise, cross and select perfume plants. The Station has begun preparing and studying the essential oils of citrus-trees, basil, *Origanum*, *Artemisia aborescens*, etc (*Atti del R Istituto d'Incoraggiamento di Napoli*, Series VI, Vol LXXXIII, Part I, pp 59-65 Naples, 1922).

Re-organisation of Cheese-Making Research and Instruction in Italy and Abroad. — About 40 million hectolitres of milk are produced annually in Italy, at least half being absorbed by the dairy industries, while the rest is consumed in its natural condition. There are over 6000 cheese factories in the country, these are situated chiefly in Lombardy, Emilia, Piedmont, and Veneto. Less than 1200 of the factories are run on co-operative lines, and about 80 % do not work up more than 10 quintals of milk per day. The annual output of dairy products is about 2 million quintals of cheese and 250 000 quintals of butter.

The existing scientific and teaching institutes devoted to the dairy industry are: 1) The Experimental Cheese-Making Institute at Lodi (its function is chiefly didactic), 2) The Royal Stock-breeding and Cheese-making School of Reggio Emilia, 3) the Cheese-making Section attached to the School of Practical Agriculture at Brescia. Cheese-making courses are also held by the Travelling Agricultural Schools of: Udine (in the Dairy-School at Piano

d'Arta), Sondrio, Bergamo and Milan; a section for practical instruction in cheese-making has been opened at the Agricultural School of San Michele, in Trentino, and short courses in cheese-making are held at intervals in several Agricultural Schools, especially in that of Sassari.

The chief foreign institutes for research and instruction in cheese-making are.

Switzerland: 1) Agricultural Experiment Institute of Liebefeld, near Berne, founded in 1901 and divided into the following sections: a) Institute of Agricultural Chemistry; b) Experimental Cheese-making Station with dairy attached; c) Bacteriological Laboratory; d) Cantonal School at Rütli (Bernische Molkereischule), which also acts as an Experiment Station especially in technical matters, 3) Dairy School annexed to the Friburg Institute of Agriculture; 4) Cheese-Making School at Moudon

France — As a rule, cheese-making is taught in the Higher and Secondary Agricultural Schools where courses of 18 to 20 theoretical lessons in dairying are held. At the Rennes National School of Agriculture, a supplementary theoretical-practical dairy course lasting one year is held. The dairy schools of highest standing in France are those of Poligny and Mamirolle. The practical schools of agriculture and dairying give elementary instruction in the second and last year of their course. The Dairy Station of Surgères (Charente-Inférieure) is chiefly engaged in research on butter.

Germany — In 1922, this country had 16 scientific dairy institutes counting the properly so-called Dairy Stations ("Milchwirtschaftliche Institute"), and the Experimental Cheese-Making Sections attached to Agricultural Stations. The Cheese-Making Schools were 23 in number, some of them being attached to Experimental Cheese-Making Stations, or Agricultural Schools. According to the amount of instruction given they are divided into Higher Schools with a two years course, and Lower Schools with a six-months course.

Sweden — 1) Dairy Institute attached to the Higher Institute of Agriculture at Alnarp, where a higher and a lower course are held, 2) Dairy Experiment Station at Hamra, instituted by the Separator Company; 3) Numerous practical Dairy Schools belonging to private cheese-factories

Hungary: 1) Higher Dairy School at Sawar; 2) 5 practical dairy schools for male and female students to be trained as fore-men and fore-women.

Argentina — The largest institute where cheese making is taught is the National School of Dairying and Pasture-Cultivation ("Escuela Nacional de Lechería y Praticultura") of Bell Ville, near Cordova, which is divided into three sections, for dairying, stock-breeding and forage-growing respectively.

The following are the chief suggestions made by the author: The creation of. 1) an Office at the Ministry of Agriculture for the general coordination of the Cheese-making industry; 2) A Technical College of National Cheese-making composed of the technical experts in the country. This College should meet at the Ministry of Agriculture and draw up an annual programme for the dairy industry, based on the recommendations made by Experiment Stations, Cheese-making Schools, Dairy Schools, Cheese-making and Commercial Organisations. The statistical, technical, professional, experimental, commercial and legislative sides of the question must all be taken into account, and the work done in the country annually noted and estimated.

ed with a view to making known the most tangible and immediately practical and economic results and also to obtaining a basis upon which to formulate regulations to be incorporated into new programmes aiming at a further extension of the existing work

The executive organs of these programmes must be the Experiment Institutes, the fixed cheese-making schools, the travelling cheese-making schools, the commercial organisations and public bodies engaged in drawing up the cheese industry statistics and in recording the progress which is gradually being made in this important branch of agricultural work

3) Institute for Research and Higher Instruction in cheese-making.

4) Fixed cheese making Schools.

5) Travelling Cheese-making Schools (G. FASCETTI, Riorganizzazione della sperimentazione e dell'insegnamento del caseificio in Italia, *Annali dell'Istituto sperimentale di caseificio di Lodi*, Vol I, Nos 5-6, p 151 Lodi, 1922)

Experiment Laboratory of Phytopathology in Turin. — Under the Royal Decree of April 26, 1923, No 1024, the Autonomous Phytopathological Observatory of Turin - established by Royal Decree of May 3, 1914, No 425 — takes the title of Experimental Laboratory of Phytopathology, and assumes the functions of Regional Phytopathological Observatory which were previously exercised by the Autonomous Phytopathological Observatory of Turin

Report of the Experiment Station for the Cultivation of Java Tea (West Indies), for the Year 1922. — 1922 was a year of much economic difficulty which increased the work of the Station. Owing to the desire of reducing labour most of the plantations were less carefully tended, with the result that the plants were more attacked by animal parasites and by disease, although in other cases, an attempt was made to face the crisis by improving the quality of the product. Whichever plan was adopted, frequent recourse was had to the advice of the Station, 2600 requests for consultations being received in 1922, as against 1200 to 1300 in the preceding years. In spite of the crisis, the number of members contributing to the upkeep of the Station has fallen off but very little.

An attempt was made in 1922 to amalgamate the Tea Experiment Station with the Indiarubber Station of West Java, this amalgamation will probably be definitely effected in 1923. The report states that 84 plantations were inspected in 1922.

Diseases — As a rule, the tea had suffered from "red rust" and the attacks of *Helopeltis*. Owing to the drought, injury was also done by *Brevipalpus*, *Tarsonemus*, *Phytopsis* and *Tetranychus*, especially in the east and central parts of the island. Serious damage caused by red spider (*Tetranychus bioculatus*) was noted for the first time in one plantation. This parasite, which is much dreaded in British India, has been successfully controlled by various insecticides, those with a sulphur base being specially effective.

Some plantations have suffered from the attacks of larvae: *Andraca bipunctata* in Java and *A. apodecta* in Sumatra. The presence of a geometrid (*Baormia*), whose parasite is unknown, has been recorded for the first time.

An *Acanthopsyche* habitually parasitic on *Albizia* has caused great injury in Sumatra both to its accustomed host and to the tea-plant. The attacks

of *Phytorus*, *Microserica*, and *Helopeltis* have been successfully controlled in the above island. The following root diseases have been reported from some plantations: *Armillaria* (which disappears in 6-8 years), *Rosellinia*, *Fomes* and *Doria* (controlled by surrounding the infected areas with deep trenches and liming the soil of the plantation).

Green Manuring — The economic trouble has helped to convince many planters of the use of green manure. A large number of tests were made with leguminosae in 1922.

Tea-seed is only controlled to a limited extent in Java.

Experiment Ground — The Government has promised the Station 120 hectares of land, which will be placed at its disposal in 1923. At Tynjiroean, the Station possesses sufficient ground for 20 tea-gardens for the production of selected seed; half this land has already been cleared.

Chemical work — In 1922, 1600 soil samples and 1000 samples of tea were analysed.

Botanical work — In 1922, the first microscopic preparations of tea-leaves were made. The study of the root system of the tea-plant (concerning which all data were practically wanting) has also been begun.

Selection Work (1)

The report also contains some further entomological observations and promises that special publications on this subject will be forthcoming.

The correlation between the production of some plantations and meteorological factors is shown by two diagrams and several tables (*Mededeelingen van het Proefstation voor The* Verslag over het jaar, 1922, No LXXXIII, Batavia, 1923).

Forage Plants Introduced into the Republic of Dominica. — The "Estación agronómica" of Haina has introduced and acclimatised the following forage plants of which it has already begun to distribute small quantities of seed to agriculturists: "yerba elefante" (*Pennisetum purpureum*), and "caña japonesa", or "caña Uha" (*Saccharum japonicum*), heavy yielders for cutting — "yerba Natal" (*Tricholaena rosea*) and "yerba Rhodes" (*Chloris Gayana*) pasture plants — "Kaffir corn" (a variety of sorghum) cow pea (*Vigna Catjang*) for poultry feeds. The first four are distinguished by their drought resistance (*Secretaría de E. de Agricultura e Inmigración, República Dominicana, Revista de Agricultura*, Year XVII, No 1, p 45, San Domingo, 1922).

Swiss Forestry Station. — In Vol XII (1922) of the *Mitteilungen der Schweizerischen Centralanstalt für das forstliche Versuchswesen*, Dr E. ENGLER publishes an article dealing with the physical properties of arable and woodland soils. The first part describes the practical methods adopted in research on the physical properties of soil (determination of the solid volume, of the volume of water, the volume of air and of permeability).

Congresses and Conferences

The Recommendations of the XI International Congress. — On May 28 last, the *Congrès international d'Agriculture*, which had been attended

(1) This subject, on account of its great importance, will shortly be treated in detail in a following number.

by the delegates of many States, terminated its work at Paris. At its closing Session, the International Agricultural Commission was complete, the representatives of two new States, Poland and Czecho-Slovakia being also included

Then follow, expressed in brief terms, the resolutions passed and the recommendations made by the Congress with a notice to the effect that those recommendations, which specially refer to general questions of agricultural economy, are give *in extenso* in the *Rivista Internazionale delle Istituzioni Economiche e Sociali*, Year I, No 3.

I SECTION: AGRICULTURE -- 1) *The Legislative protection of new plants*, which are to be regarded as patented products, exact and severe regulations to be passed to prevent the fraudulent sale of new varieties of seed-wheats and to control the names under which they are sold — 2) *The Constitution of an International Association of Plant Selectionists* supported by the various Governments and connected with similar national Associations. — 3) *The Co-ordination of Studies of Cereal Rusts*, it being suggested that for the present, HAVES and STAKMAN'S scale should be adopted for determining rust resistance — 4) *Protective Measures Against Degeneration in Potatoes* based on systematically conducted studies, the encouragement and popularisation of seed tubers election, the selection being controlled and guaranteed by a certificate of authenticity, the immunity of the seed potatoes from the serious parasites, *Doryphora* and *Synchytrium* being especially vouched for by a certificate of the country of origin — 5) *The widest employment of agricultural machines* favoured by the Governments and Associations and the organisation of practical instruction for rural mechanics

II SECTION. *Influence of Agriculture upon International Relations.* — 1) *Development of international relations between Agricultural Associations with the object of peace propaganda* (See, *Riv Int delle Istituzioni Economiche e Sociali* mentioned above) — 2) *International Institute of Agriculture*. Recognising the services already rendered by this Institute, the Governments ought to study the means by which its efficiency can be increased, in order that agriculturists may in their turn derive the fullest benefit from its work — 3) *Unification of the methods of customs control* on the basis of the conclusions announced by the International Conference held at Paris in 1910. — 4) *Regulation of the trade in commercial products* (See, *Riv Int delle Istituzioni Economiche e Sociali* already mentioned)

III SECTION: *Rural Economy* — For most of the recommendations made respecting this section, and in particular for: 1) *The material and moral improvement of rural workers*, 2) *Agricultural Associations*; 3) *The System of Land Transfer in various countries and the means of reducing its cost*; 4) *Agricultural profits and fiscal burdens on agriculture*; 5) *Financial independence of professional agricultural organisations*, 6) *Agricultural Politics*, 7) *Improvement of the social conditions of agricultural workers*, See *Riv. Int. delle Istit. Econ. e Soc.* mentioned above As regards agricultural book-keeping, it was suggested that the elementary knowledge of this subject should be imparted in rural districts both by means of instruction in the schools and text books in the subject, and that co-operative societies should institute special book-keeping offices for the assistance of all agriculturists and especially of the poorest; special

instruction being provided for training administrators, directors, and book-keepers for the various agricultural associations. It was also suggested that similar methods of analysing agricultural management should be adopted in all countries, in order to facilitate international exchange of views

One of the suggestions made by Section III, Sub-section of *Agricultural Instruction* (See *Riv. Intern. d. Econ. e Soc.*) was that the *primary schools* should have specialised teachers and that the theoretical instruction should be supplemented by practical demonstrations in the gardens annexed to the school, in the fields and neighbouring farms. At the same time, the professional career of the teachers who devote their time to imparting agricultural knowledge must be considered, either by promoting them on the spot, or giving them certain increments to their salaries, or scholarships for their children, so that they may provide their family with as good an education as if they lived in the town. As regards *trade schools*, the development is recommended of winter schools, schools of domestic economy, continuation schools, apprenticeship instruction, correspondence classes, regimental schools, etc.

IV SECTION. *Cattle Economics* — 1) Institutions for the control of the yield and feeding of milch cows would afford a means of developing and selecting dairy stock. The Congress not only recommends an extensive propaganda in order to extend the cultivation of forage crops, but also urges the institution and development of co-operative dairies, the formation of syndicates for the common purchase of breeding stock, and the wholesale purchase of stock-feeds, fertilisers etc., the development of good cheese-making schools, the organisation of rapid means of transporting milk and its derivatives, the adoption in the different countries of uniform measures for controlling milk and butter production (sample-taking, weighing, certificates), the practical and scientific instruction of expert milk controllers — 2) The Congress urges the necessity of the different countries to adopt the same rules for judging breeding-stock (these rules being in accordance with the principles directing scientific breeding) and the regulations for the registration of stock in *pedigree books*. The latter, for instance, should be closed, and after they are closed, no animals should be registered unless they are the offspring of parents already on the register, in which case, as a rule, a confirming test is also to be required — 3) the adoption in the various States of *health certificates* and of *certificates of origin*, like those granted in Holland, was also recommended — 4) The formation of a *Permanent International Breeding Office* to deal with matters relating to the improvement and economics of live-stock was proposed — 5) *The unification of breeding methods* was recommended — 6) Also a detailed book-keeping system supplying exact data respecting mechanical traction, and finally — 7) the Congress recommended that the study of foot-and-mouth disease should be carried out in all the different States

V SECTION: *Vine-growing* — It is recommended that: 1) the Countries which signed the Treaty of Versailles should proceed to the unification of the laws made for the purpose of protecting the *declaration of origin of wines* by extending the *Convention of Madrid* and organising a Committee of the Latin Union to consider the international measures to be taken for the purpose of insuring the genuineness of the said products — 2) the methods of chemical

analysis should be unified in accordance with the Paris Convention, October 16, 1902 — 3) the attention of the various Governments should be drawn to the exaggerated measures of the Prohibition campaign — 4) in spite of the progress attained in *crossing vines*, in order to avoid the economic consequences of over-production, no undue extension of vine cultivation should be attempted. In no case, should hybrid bearers be used in districts producing fine wines.

VI SECTION *Sylviculture* — The Governments should: 1) encourage the *intensification and improvement of forest-tree cultivation* by means of pecuniary assistance and other support both of a material and moral character. — 2) Combine to coordinate *forestry studies of a strictly technical nature*. — 3) Develop measures of protection and insurance against *forest fires*

VII SECTION *Agriculture in Tropical Countries* — 1) *The Development of Colonial Agricultural Products* by means of close collaboration between the Administrations of the colonies and individual traders, and by extending the technical knowledge of the natives engaged in various branches of agricultural work — 2) *Economic development of stock-breeding and the control of epizootic diseases* — 3), 4) and 5) *Financial problems of the Colony, the feeding, medical assistance and recruiting of colonial workers* (See, *Riv Int d Institut Econ Soc.* above mentioned) — 6) It is recommended for the *protection of tropical crops* that regulations should be passed in all the Colonies, in accordance with the final resolution of the International Conference at Rome, of March 4, 1914, and suitable offices established in the several Colonies — 7) In order to extend the use of *improved methods in growing Colonial crops*, it is recommended that scientific institutes and museums should be founded, and assistance given to scientists desirous of studying colonial agriculture — 8) It is finally recommended that engines running normally on motor fuel should be studied, in order to extend the use of *Agricultural tractors*

International Conference for the Study of Means of Controlling the Olive Fly ("mosca delle olive") Madrid, June 18-21, 1923. — This Conference, which was announced in No 1, of the present Review, (see p 257) had been convoked on the initiative of the Spanish Government as a result of a decision made by the International Institute of Agriculture in Rome, and was held in Madrid in the building of the "Ministerio de Fomento" from June 18 21, 1923, being attended by the representatives of France, Greece, Italy, Peru, Portugal and Spain

The Conference passed the following resolutions:

1) That it is advisable to create compulsory associations amongst olive-growers for the defence of their property against the Olive-fly (*Dacus oleae*)

2) That it is necessary to continue the experiments connected with the artificial control of the olive-fly. These experiments should be continued for 3 or 4 years in the same place and under the same conditions in order to compare the results and decide as to the effectiveness of the remedies.

3) That since both spraying with toxic and sugary substances, and the use of locally-set poisoned baits have been considered effective in various countries, the Conference is of opinion that both these methods should be studied, without however excluding any other remedies which each State may consider to be effective in the control of the pest

4) In so far as the laws controlling the use of arsenates in agriculture permit (for these differ in each State), the Conference is of opinion that it is advisable to begin new experiments based on the use of arsenical compounds other than the soluble arsenates hitherto employed, and recommends especially lead arsenate and other products toxic to the olive-fly.

5) The Conference expresses the hope that the International Institute of Agriculture in Rome will cause the question of patents to be studied, so that the maximum liberty may be granted to the olive-growers in the use of artificial means of destroying the olive-fly

6) The Conference is of opinion that the results of all the experiments, together with the details respecting the application of the remedies in different countries should be laid before the International Institute of Agriculture, in Rome, in the first half of October in each year. The Institute should communicate the said results to the interested countries without any loss of time

7) The Conference considers that it will be necessary to discover whether the methods hitherto employed, and which are recognised as destructive to the olive fly, may not also prove injurious to the olive-tree owing to the possible development of fumagine and the destruction of useful insect parasites of the olive-fly which like the latter, live on sugary substances

8) That all olive-growing countries should appoint experts to study, according to a common plan, the life-history of the olive-fly and its parasites, with special reference to the environmental conditions. The creation of insectarii with experiment fields is especially to be recommended for this purpose

9) The Conference expresses the hope that the Governments of European olive-growing countries will urge those of North Africa, India, South Africa and West Africa to make an exhaustive study of the olive-fly and its parasites in their several regions

10) An endophagus parasite (*Opius concolor*) of the olive-fly having been met with in North Africa, the Conference is of opinion that a common effort should be made to acclimatise this parasite in Europe

11) Given the existence of endophagous and ectophagous parasites of the olive-fly in West Africa, a country with a climate resembling that of South Europe, the Conference advocates a united effort being made to introduce these parasites into Europe

12) The Conference expresses the hope that a permanent International Commission of experts will be appointed with a view to studying the various questions concerning the olive-fly. This Commission should meet at least once a year. The first meeting should be held at the International Institute of Agriculture in Rome. The place of the following meeting shall each time be fixed at the meeting

13) The Conference recommends the various Governments to found in the manner they think most suitable "Olive Banks" of which the funds will chiefly be used to control the olive-fly

14) The Conference hopes that the various States will agree to unify the national legislation with the object of facilitating the purchase and employment of the substances required for the control of the olive-fly, a pest to man and animals

15) The Conference hopes that the Fiscal Authorities will reduce the taxes on substances intended for olive-fly control

16) The Conference considers it necessary to extend judicious protection to many birds which render service in destroying insects, especially those into the olive-tree

International Wine Conference. — On June 4, 1923, was held at the French Ministry of Agriculture, an international conference of wine-producing countries for the study of the following questions: propaganda, unification of the regulations adopted in vine-growing countries for the repression of fraud and the protection of declarations of origin — the creation of an international wine office for the application and co-ordination, in every State, of questions of international control.

Pomological Congresses in France. — 1) *Congress of the "Société pomologique de France"*, Strasburg, September 7-8, 1923, inaugurated under the auspices of the "Association Centrale des Arboriculteurs d'Alsace et de Lorraine", and of different horticultural societies united for the purpose. Questions treated of. 1) The object and organisation of experiment orchards; 2) Partial soil sterilisation in fruit-culture, 3) Effect of climate upon the intensive cultivation of table fruit; 4) The best treatment of trees in intensive fruit-growing, 5) Causes determining tree-fertility and fine fruit, 6) Grafting: effect of scion on stock, 7) Note and observations on rolling, moulds, *Monilia*, and on pruning fruit-trees, 8) Study of Alsatian fruit-growing. Communications to be addressed to the Secretary-General of the Société pomologique de France, M. Louis Chasset, 1 Rue Saint-Symphorien, Versailles

2) *Pomological Congress of Toulouse* — The "Société pomologique de France" has agreed to meet and hold a Congress in 1925 at Toulouse, under the auspices of the "Société d'Horticulture de la Haute-Garonne", and the "Compagnie des Chemins de Fer du Midi". At the same time an Agricultural Industrial Show will be held

National Agricultural Congress in China. — The report of this Congress, which was held in 1922, can be obtained from Dr P. W. TSOU (Dean of South Eastern University), Nanchino, China, (*See World Agriculture*, Vol. III, No. 1, pp. 15-22-23)

Association of Official Agricultural Chemists of New York. — The 39th meeting of the Association was held from November 15 to 17, 1922, at Washington, 360 members being present. In addition to the usual reports, various papers were laid before the Association. In connection with the reports of the food experts, BAILEY of the Society of American Oil Chemists, presented to the Association of Agricultural Chemists a report of the work of the North American oil chemists for the improvement of the technique of food stuffs analyses. They had received samples of cotton-seed cake and cakes of other seeds in order conjointly to estimate the moisture content, and the ether, petroleum, and ammonia-soluble substances. At the present time, 75 collaborators are engaged in this work. At frequent intervals, samples are sent to them for analysis, and they communicate their findings to the Association by which the averages of all the data are obtained and sent to the various collaborators. On the second day, the President gave a lecture

describing the work and the responsibilities of the Government Agricultural Chemists.

Congress Commemorating the Fifty year's Anniversary of the Agricultural Stations and Agricultural Laboratories of Belgium. — This Congress was held in Brussels on May 17, 1923, under the patronage of a Committee presided over by the Minister of Agriculture, and composed of the representatives of the Agricultural Services, and of the chief, agricultural and scientific Institutes, as well as of those of the various industries connected with agriculture. The Congress included two sections: 1) Agricultural research; 2) Control of raw materials and agricultural products and repression of frauds. Secretary: J. GRAFTIAU, Boulevard de Diest, 113, Louvain (Belgium).

Congress of Algerian Tobacco Planters. — Held on June 5, 1923, at the Office of the "Confédération générale des Agriculteurs d'Algérie", 1 Boulevard de la République, Algiers. It was attended by over 200 tobacco planters, the Co-operatives of Bona, Kabylia, El-Afron and the Boufarik Syndicate of Tobacco Planters being largely represented. The following questions were discussed: 1) The right of entry of foreign tobacco in leaf-form; 2) Results of the Customs Union with Tunisia; 3) Improvements in the cultivation, drying and fermentation of Algerian tobaccos; 4) Formation of a Co-operative Society of tobacco planters for the foreign sale of leaf-tobacco; 5) Contracts with the Revenue Office. (*Revue agricole de l'Afrique du Nord*, No 202, June, 15, 1923).

Organisation of the "Comité National du Blé" in France. — The members of the Congress of the National Wheat and Bread Week, decided before separating to form an inter-professional executive Committee to carry into effect the resolutions passed at the Congress.

This Committee has now been appointed under the name of "Comité central du blé et du pain". It has decided to establish wheat and bread Committees in every Department and, in order to facilitate communications between the Department Committee, it has been decided to unite the Departments into regional groups arranged according to the consensus of the different trades in such a manner that each group contains Departments producing similar if not the same, types of wheat.

Exhibitions and Meetings.

International Exhibition of the Pasteur Centenary, Strasburg, June-October 1923. — Includes the following sections: Scientific and Applied Hygiene — Science — Industries — Dwellings — Food — Agriculture.

International Piscicultural Exhibition, Leeds, England, September 24-October 6, 1923. — Inaugurated by the Universal Exhibitions Ltd 22-24 Great Portland St., London W C

International Exhibition of Woods and the Wood Industry. Lyons, October 6-21, 1923. — This forms part of the Lyons Fair. For further information, apply to: Hotel de Ville de Lyon, France.

Special Show of the Tarantais Breed of Cattle at the Savoy Departmental Agricultural show at Saint-Jean-de-Maurienne, Octo-

ber 13-14, 1923. — Applications to be made before October 5, to the " Directeur des Services agricoles de la Savoie " 2 Place du Château, Chambéry

IV French Competition for the Cultivation of the Finest Ear of Wheat (1923). — This Competition was organised by the Bordeaux Press, and has been held every year from, and including, 1918. It is under the patronage of the Ministry of Agriculture, the Departmental Agricultural Office of the Gironde and other Bodies

The objects of the Competition are: 1) to promote and popularise the practice of selecting the hardiest local varieties of wheat producing most grain and which have the highest milling and breadmaking yield, in order to obtain the maximum production of good bread per unit of surface; 2) to interest the youth of France in wheat cultivation

The competition is open to all cereal growers in France. A special section is reserved for French students

Each group must be gathered at harvest time from the healthiest stools bearing the best developed ears composed of the greatest number of spikelets regularly furnished with grain of best quality, and consist of 4 plants (2 at least being complete) bearing the finest ears in the field. A set of questions is sent to each competitor

Classification of the Ears. — The Competition is divided into two parts, a provisional and a definitive test respectively. The first includes two classes. First class *a) Scientific Part*: A preliminary inspection of the ears will be made by the delegates of the Bordeaux scientific Societies (Société Linnéenne, Société de zoologie agricole, Société d'Agriculture, Société d'Horticulture) and of the State Stations appointed by the Ministry of Agriculture (Station agronomique, Station entomologique, Station de Pathologie végétale de Bordeaux). The objects of this examination are to determine the botanical character of the ears, to identify the variety scientifically, and to analyse the grain, in order to ascertain its industrial value, in short, to obtain the data for drawing up the form to be presented to the judges

b) Technical part. After the ears have thus been investigated, a mixed commission of agriculturists, corn-dealers and millers will give marks for cultivation and industrial classification, these taken together will classify the ears provisionally, and confer the right to an encouragement prize

c) Second class Selection. From every group of plants, 4 of the best ears shall be removed by the mixed Commission, one of these ears is to be returned to the competitor for cultivation, the second is to be given to M. Rachel SÉVÉRIN (Technical Director of the Competition) to be grown at the same time in his experiment field, while the remainder are to remain as proofs with M. BRETHER, the organiser of the Competition

d) Selection cultivation. Definite instructions shall be sent to each of the competitors to the effect that every single grain of the chosen ear shall be grown under the same conditions, the most fertile and hardiest of the resulting plants being noted

Final Classification. — After the following harvest, the competitors shall present to the Commission the finest stools with the best ears obtained by selection cultivation. Their exhibits will be compared with the specimens ob-

tained in M SÉVÉRIN's experiment field If the result is favourable, the chosen grain is returned to the competitors to serve as a basis for seed-propagation.

The final classification is founded on the total number of marks obtained with two exhibits The medal presented by the " Société Nationale de la Meunerie Française " shall be awarded every year to the variety of wheat finally classed as having the highest milling and bread-making qualities, since the chief object of the competition is to develop the good qualities of wheats capable of furnishing the largest amount of bread per surface unit

Competitors are requested to attack to the best ears, specimens of the injurious plants that have invaded and infested the crops during 1923, in the districts where the said ears were grown

Entries to be sent to the Société Linnéenne, Athénée Municipal, Salle 11, Rue des Trois-Conils 52, Bordeaux, and correspondence addressed to M BRETHE 32, Rue de Lyon, Bordeaux

Horticultural Exhibition, at Paris, October 26-November 5, 1923.

— This exhibition inaugurated by the " Société nationale d'Horticulture de France," will be held at the Cours la Reine Horticulturists, amateurs, gardeners, dealers in garden-produce, teachers of horticulture, Directors of Botanic Gardens etc landscape gardeners and dealers in gardening material, who wish to take part in this Exhibition should communicate, before September 26, with the Président de la Société National d'Horticulture de France, Rue de Grenelle, 84, Paris The regulations and programme are published in the *Journal d'Horticulture*, Series 4, Vol 24, p 91 Paris, March 1923

Prize of 200 Francs for the Finest Onion (Improved Rocambole). —

The competition will be held at the show arranged by the " Société nationale d'Horticulture de France," in October-November 1923 The competition is for the best lot of 3, or 4, Rocambole-Amélioré (var Aryan) onions and is open to all amateurs, horticulturists etc One prize will be awarded by the Show judges The entire plant with roots must be forwarded

Exhibition of Food Products, Amsterdam, Holland, November 22-December 5, 1923.

Exhibition of Sugar Beet Seed, Paris, 1922. — The " Commission des graines de betterave a sucre " of the French Ministry of Agriculture has decided to inaugurate an exhibition of sugar beet seeds which is to be held in Paris in 1924, on the occasion of the General Agricultural Show The exhibition will include: Chemical and physical apparatus for selection, apparatus for sorting and drying the seed, exhibits of firms engaged in selection, diagrams showing production etc There will be lectures, and a cinematograph

The Cruise of the " Terre de France ". — The exhibition ships, " Terre de France," began her first cruise in April She sailed from Havre and touched at Lisbon, Casablanca, Madeira, Dakar, Buenos Ayres, Montevideo, Santos, Rio de Janeiro Baffia, Pernambuco, Port of Spain, La Guayra, Port-au-Prince, Havannah, Vera Cruz, New Orleans, Philadelphia, New York, Boston, Quebec and Montreal, remaining 4 to 15 days in each port The cruise will last 8 months The ship (20 000 tons), is fitted with stands and showcases and provided with exhibition halls and refreshment rooms, reception rooms and a cinematograph Sales with immediate delivery are effected on board

Military Competition for Agricultural Tractors in France, 1923.—

The resistance test to which heavy and light tractors for the military competition of 1923 are subjected may be summarised as follows. The agricultural tractors must be of such construction that they can be used for horse-drawn artillery material up to a weight of 4000 kg in the case of heavy tractors, and up to 1600 kg in that of light tractors, especially on fairly light soil, or ground that has been torn up by shell-fire, etc. The maximum weight of the tractor, without the driver, shall be respectively 3700 and 2500 kg. The speed shall range from 6 km per hour on good ground, to 15 km on slopes not exceeding 20 % in the case of heavy tractor, and 30 % in that of light tractors. The average consumption per kilometre-ton (reckoned on an entire run of 40 km on fairly diversified ground) of a tractor hauling a wheeled load about 4 tons in the case of a heavy tractor and 16 ton in that of a light tractor, should never exceed 3 decilitres (motor oil or benzine) or 35 centilitres (motor spirit with 50 % of benzine). In short, the supply of fuel, lubricating oil and water shall be sufficient to enable the machine to work for 8 hours without replenishing (*Le phosphate et les engrais chimiques*, Year XXXII, No 1373, Paris, 1923).

The "Automobile Club de France" Competition for Explosion Engines.— In 1923, the field trials will take place in the South-West area. Communications to be addressed to the Marquis de Vogüé (President of the "Commissione agricole de l'Automobile Club de France") 8 Place de la Concorde, Paris.

Hay-Binder Competition in France.— A Hay-binder Competition will be arranged for 1923, or should this prove impossible, for 1924, by the "Syndicat des agriculteurs de la Manche" under the auspices of the "Office agricole régional du Nord", and of the "Office départemental de la Manche". The organisers request the constructors to enter a machine with a maximum width of 2.40 m. for animal tractor (by 1 or 2 horses) capable of binding into bales or loose bundles of about 5 to 10 kg the hay lying on the ground, or collected into swathes. Other things being equal, preference will be given to machines binding bales, or bundles, weighing 5 kg or less. For further information, apply to the "Syndicat des Agriculteurs", 1 Route de Lessay, Coutiléc, or else to the "Direction des Services agricoles de la Manche, Saint-Lô".

First National Exhibition of Cheese Industries and Trades will be held at Milan in November, 1923.

Competition for Wines from Hybrid Vines in France.— In some districts, of France, exhibitions of wines from hybrid vines have been organised. The "Société d'Agriculture de Mâcon" held its fourth competition for such wines in January 1923, more than 250 samples from 14 Departments were entered. After the exhibition organised at Toulouse by the "Syndicat agricole de la Haute-Garonne" the President of the Syndicate himself drew up an exhaustive report giving the remarks of the judges with regard to the 367 samples presented and ending with the following words: "This report will show vine growers that the wine-making value of a large number of hybrids is undoubted. Hybrid wines exist from which perfectly palatable wine can be made, it remains for the vine-growers to choose the varieties that best suit their special

conditions. We do not, however, consider our task finished, for it will only gradually be possible to bring forward the most notable hybrid vines and the wines made from them, but we have every hope of succeeding in determining the best varieties and thus relieving vine-growers from the labour entailed by the copious irrigation required by the *viniferae*".

The President points out that it has again been proved that the same hybrids do not give equally good results in different localities (*Journal d'Agriculture pratique*, March 31, 1923)

Travelling Exhibition in France. — The Paris-Orléans Railway has organised, in conjunction with the "Comité de la Semaine nationale du Blé", a series of travelling exhibitions of the best varieties of cereal seed. Three large railway carriages specially arranged for the purpose make the round of the Central Departments. The visitors will be shown the culms, ears and grain of the most productive varieties, and will be given information respecting the characteristics of these varieties, the improvements to be introduced into cereal cultivation and the method of laying out experiment fields for the comparative study of the selected and the local varieties.

In order to intensify poultry and bee production, as well as to encourage the trade in farm-yard produce and honey, the same Company has begun to send round, in several departments, vans containing poultry-yard and apiary material, and the species of poultry that it is advisable to rear. Thus, from February 22, to March 2, two large-sized vans containing various types of implements and accessories, as well as wall-diagrams showing the natural history and method of rearing bees, will stop at the different Departments of Finisterre, Morbihan and Loire-Inférieure to allow bee-keepers, to visit the exhibition. The Company is studying the question of organising travelling exhibitions for the products of other branches of agriculture.

Agricultural Exhibition at Rheims. — The "Comice agricole" of Rheims has organised, for the first time since the war, an exhibition of live-stock and agricultural implements and products. The exhibition was held in June 1923, and proved that the reconstruction work, at all events as far as soil cultivation concerned, is almost finished in the Department of Marne.

General Exhibition of Breeding Stock at Paris. — The "Concours général d'animaux reproducteurs" organised by the French Ministry of Agriculture was held in June 1923, in the Champ-de-Mars, at Paris. The exhibition catalogue gives the number of cattle, sheep and swine entered as 245 without counting the animals sent by the Breed Syndicates of different districts. The animals exhibited included: 648 cattle — 203 rams and lots of ewes — 71 swine — 7 milch-goats — 21 sheep-dogs. The number of cows entered for the milk and butter competition was 99. The cinematograph installed in the Exhibition court proved a great success (*Journal d'Agriculture pratique*, June 6, 1923).

Competition of Viticultural Machines in France. — The "Comité d'Agriculture de Beaune et de Viticulture de la Côte-d'Or", has inaugurated trials for machines used in vineyard cultivation. For information as to results, apply to M. Chapot, Professor of Agriculture at Beaune, Côte-d'Or.

Exhibition of Agricultural Material at the Paris Fair. — This was held from May 10 to 25, 1923 shortly after the exhibition of the "Salon

de la machine agricole" It gave visitors the opportunity of seeing the machines in motion The following new machines were exhibited: 1) *Cultivating machines* motor-plough "motocharrue piocheuse" — vineyard motor-plough MALLY system — "Quadrill" planter and seed-drill for hoed crops — automatic grindstone for sharpening scythes, 2) *Machines for preparing grain*: small threshers — thresher attached to strawstacker — threshers with OLIVIS grain-stooker — automatic sheller, 3) *Engines, etc* LAW electric engine — apparatus for electric ploughing — automatic electric pump — "Sylvia" saw for trimming trunks — "Fleus" electric and explosion engines-economical petroleum engines — heavy oil engines — "Estia" gasogene, 4) *Pumps, machines and various implements*

Egg-Laying Competitions in India. — The first egg-laying competition in India was held in 1920-21 by the United Provinces Poultry Association and proved such a success that it was decided to hold a similar competition every year The first and second competitions were both limited to the 3 winter months At the first, the winning hen was a Light Sussex which laid 65 eggs in 92 days Eighty hens took part in the second competition and laid a total of 3320 eggs (*The Agricultural Journal*, Vol XVII, Part V, pp 483-488, Calcutta, 1922)

Exhibition of Agricultural Machines at Brno, Czecho-Slovakia. — held from August 5-15, 1923, all the factories of agricultural machines in Czecho-Slovakia sent exhibits

Miscellaneous

Information Bureau for the Belgian Congo. — "The Service des conférences et informations", Brussels, Rue de Buysbroeck 28, which supplements the 'Office colonial', supplies general information on the Belgian Congo It organises exhibitions, lectures and cinematograph representations of colonial scenes, lends negative and films, and supplies propaganda literature dealing with the Belgian Congo

The American Forestry Association. at a meeting of its Directors held on April 24, 1923, accepted the proposal of the National Conservation Association to enter the Forestry Association of the United States The amalgamation was to enter into effect from June 1 (*American Forestry*, Vol 29, No 354, Washington, 1923)

The World's Record of Milk Production was broken by Aggie, a Holstein-Friesian cow belonging to M D U Hnemunk of Cedar Grove (Wisconsin, U S) Aggie was sired by a Holstein bull whose ancestors had been carefully selected for producing milk with a high fat content

Sowing by Aeroplane. — Sowing from an aeroplane has been carried out in California, where in the neighbourhood of Lake Tulare, the soil is excessively damp and cannot be worked at the sowing season, which makes it very difficult to carry out seeding in the ordinary manner Finally, an aviator flying at a height of 15 m succeeded in scattering 360 kg of seed over 65 hectares of this land The seeds went deep enough into the soil to insure germination The cost of this method of sowing is estimated at 25 dollars per hectare (*Cerealia*, March 6, 1923)

Ticks. — The Bureau of Animal Industry of the Department of Agriculture of the United States has circulated a film entitled "Mollie of Pine Grove Vat" which is to assist in the control of ticks affecting livestock! It will first be shown in the tick infested zones of the Southern States (by the help of a motorcar), after which the film will be sent round according to the system of distribution adopted by the Department (*The Official Record, U S Department of Agriculture*, Vol II, No 14, Washington, 1923)

Declarations of Origin for the Protection of French Viticulture.

— The law of May 6, 1919, passed for the defence of French wines and for the repression of frauds connected therewith confers a special legal status upon declarations of origin. It was very well-received by wine-producers, so that since 1920, 12 000 declarations of origin have been registered. Numerous complaints have been made, and many sentences have been passed in accordance with the said law. The types of wine which have been defined and settled are: Chablis (Grand vin de Chablis, Chablis-Village-Supérieur, Chablis-Village) — Montrachet — Champagne — Saint Emilion — Sauternes — Monbazillac — Montravel (Haut-Montravel, Côtes Montravel, Montravel) — Bourgogne, Beaujolas, Mâconnais (Bourgogne, Beaujolais, Mâcon et Mâconnais, Côte Chalonnaise, Pouilly) (*Revue de Viticulture*, March 1, 1923)

Enquiry on "Bramble-Leaf" of the Vine in France. — The "Société Départementale d'encouragement à l'agriculture de Hérault" has decided to open a general enquiry into the character and extension of the disease of the vine known as "bramble-leaf" (*arricciamento*), "court-noué") and of the results so far obtained from the various control measures that have been tried (1). The enquiry will be made by means of a questionnaire sent to those interested. Any one having a communication to make on the subject can obtain the form from the Head Office of the Society, Montpellier, Rue Durand, 19.

The Afforestation of Uncultivated Land in France. — In addition to her forests and woodlands, France possesses over 4 million hectares of uncultivated land. M. Chéron, the Minister of Agriculture, has shown in one of his circulars the advisability of planting this land with trees. The Administration of Waters and Forests makes grants in kind (seeds and young trees), and in certain cases, in money, to private individuals undertaking afforestation operations of public utility upon uncultivated land. These subsidies which are paid out of the Budget funds are supplemented by moneys allocated to the purpose under the provisions of the law of July 31, 1920. The grants, which often cover a large part of the total cost of the work, are a great encouragement to the afforestation of waste land (*Journal d'Agriculture pratique*, No 15, April 1923).

Stock-Breeding and the Agricultural Offices in France. — Ever since their foundation, the "Offices agricoles" have greatly contributed to the improvement of the French breeds of stock. In the financial year 1921, these offices used about 10 million of their balance in the purchase of selected breeding animals, the reconstruction of herd-books, the retaining of the best parents, etc. This work was continued in 1922. To mention one instance, the "Office agricole régional de l'Est" spent 75 000 francs for the encouragement of

(1) See R. 1919, No. 933 (Ed.)

Breed Syndicates of Black Pied Cattle; this amount was in addition to the far more important grants made by the Departmental Offices of the region.

Seed Control in France. — The Committee for Seed Control which was instituted at the French Ministry of Agriculture by the Decree of December 5, 1922, met on February 2, 1923. It has defined the manner in which an analytic catalogue of the existing varieties of seed is to be made and has requested M. RABATÉ to study a registration scheme for selected plants, to record the names of persons who have obtained, or discovered, a new species, or a new fixed variety of wheat. The Committee have decided that in future, only those varieties that have not been put on the market may be regarded as being new. Selectionists desirous of having new varieties entered on the Register of Selected Plants should apply to the Minister of Agriculture (Office des Renseignements Agricoles, Paris, Rue de Varenne, 78) according to the provisions of the Decree of December 5, 1922. Finally the Committee examine and discussed the text of the draught of a decree intended to protect purchasers of seeds from abuse. The work of the Committee is confined exclusively to wheat.

Proprietary Rights in Horticulture. — These are much discussed in France with the result that the "Office National de la Propriété horticole, with office, registers and forms ready for use have been established. New plants are registered by the General-Secretaries of the special Societies (Fruit Chrysanthemum -- Rose) and by the "Société Nationale d'Horticulture de France", in the case of ornamental plants, flowers, and kitchen-garden plants (*Revue Horticole*, Year 95, No. 16, Paris 1923).

Terms Force and Power, Abbreviation HP. — One of the resolutions passed by the French Syndical Chamber of the Gas, and Petroleum Engines and Gasogenes Industry at its meeting on March 14, 1923 which should be recorded is the following. It is necessary to draw the attention of our members to the mistake they make in their use of the abbreviation H P (Horse Power). The English term H P represents about 76 kilogrammes. Since the French power unit is 75 kg, it is incorrect to use this abbreviation which represents a force of about one kg more than the French unit. It is necessary to realise the trouble that the erroneous term H P may cause the constructors, and to substitute for it the French term "cheval-vapeur" and the abbreviation C V corresponding to a weight unit of 75 kg.

The Secretary has been instructed to notify this decision to the schools, the Syndical Chambers interested in motor-power, and to the technical press (*Le Génie Civil*, Vol. LXXXIII, No. 15, p. 364, Paris, 1923).

Agricultural Electrical Cooperatives in France. — In the Department of Oise, 5 Agricultural Electrical Co-operatives with over 4700 members and a single Central Office at Compiègne were organised in 1920. The advantages of applying electricity to agriculture were demonstrated at a meeting held at that city on March 26. The object of the meeting was to determine, by a visit to the electrical works of the Compiègne district, how far it was possible to adopt this system and the effect it would have upon the sale of the energy of the rural electrical system. The visits paid to 3 electrical works showed that the system worked perfectly, excellent ploughing to a depth of 35 cm being effected by a three-shared plough handled by only

two men further, although the transverse trenches are very narrow they are not destroyed, and the cost of ploughing is relatively low (*Journal d'Agriculture pratique*, April 14, 1923)

The Cinematograph in the Country Districts of France. — From the funds set apart by the law of August 5, 1920, for the purpose of agricultural instruction, the French Ministry of Agriculture is able to make grants for the construction, or purchase, of films of agricultural interest, or for the installation and working, in the rural Communes, or Institutes for agricultural instruction coming under the law of August 2, 1918, of cinematograph apparatus whether fixed or movable intended for the popularisation of knowledge useful to agriculture, or for agricultural propaganda (*La Vie agricole et rurale*, April 14, 1923)

Teaching by Means of the Cinematograph in France. — At the present time, it is possible for the sum of 1500-2500 francs to purchase a lantern for schools, or small halls, and capable of throwing the image in a screen 2 to 2.5 m wide sufficient for a hall containing 200 or 300 people. The price of hiring educational and agricultural films at the present time is 4 centimes per metre and representation, or 10 centimes a metre per week. Hence, the hire of a film of 100 to 200 metres, that takes 5 to 10 minutes to show on the screen, 4 to 8 francs for one representation, and 10 to 20 francs for one week. The following are the titles of some of Messrs Pathé and Gaumont's films. The Crossing of Wheat — Mimicry — Karyokinesis in a Living Cell — The Germination of a Pollen Grain — The Vintage, etc (*Revue de Viticulture*, March 1, 1923)

The Draught Horse of Maine (France). — A Syndicate of breeders has been formed in the Department of Sarthe for the purpose of starting a Stud-Book for the draught-horse of Maine (Percheron type). The Office of the Syndicate is at Mans (*Journal d'Agriculture pratique*, No 8, 1923)

Vosges Cattle Breed of Alsace. — The Agricultural Director of the General Commission decided to start a State Herd-book for the Vosges Cattle of Alsace in 1922. The article gives the distinctive characters of the breed as determined for the Herd-book. Animals will be registered on the basis of: pedigree — shows — filiation. The Pedigree-book will be closed on December 31, 1925 (*Journal d'Agriculture pratique*, Year 86, Vol II, No 51, pp 523-534, Paris, 1922)

Herd-book of Flemish Cattle in France. — Opened in 1921, in February 1923, by means of the Regional or Departmental Commissions, a thousand cows and some 200 bulls were registered. For further information, apply to the Secrétaire du Herd-book Flamand, 3, Rue Saint-Bernard, Lille.

The Adoption of Ploughs in Madagascar. — The Director of the Experiment Station of Namisana states that increasing use of the plough is made by the natives in the plain of Betsimitatatra, more than 100 000 hectares of rice-field being ploughed. Hence, the work of the Society, which has been ably seconded by the Administration of the Colony, has been successful (*Les Cahiers coloniaux*, No 230, Marseilles, 1923).

The Control of Agricultural Produce on the Ivory Coast and in French Togo. — The Grand-Bassam Chamber of Commerce has passed a local bill instituting an Inspection Service to protect the kernels of the oil

palm, palm oil and cacao from fraud or adulteration. The bill states the conditions under which this control is to be effected, and the penalties to be inflicted in the case of infringement. (*Bulletin des Matières grasses de l'Institut colonial de Marseille*, No 1, 1923).

Aberdeen-Angus Herd-book. — The 47th volume of this herd-book has been published, it consists of 600 pages and contains the genealogical-tree of 2638 bulls and 2365 cows and gives the descent of the calves for two generations (*Live Stock Journal*, Vol XCVII, No 3251, pp 186. London, 1923).

Rural Telephones in Great Britain. — The Post-Master-General has announced that between May 1, 1922 and March 13, 1923, about 3100 new subscribers to the rural telephones have been registered, 85 Central Stations and 650 telephone Offices have been established, while many others are in course of construction

British Government Station for the Disinfection of Wool. — The British Government has passed the Anthrax Prevention Act and according to its provisions has opened in Love Lane, near Liverpool, a Station for wool disinfection. Dating from 1921, wool and all animal skins coming from the East Indies must be disinfected. The Station began working in June 1921.

In March 1922, disinfection tests were made with Ultra-violet rays and X-rays which permit of the disinfection being effected without the bales being undone, the tests gave good results (*Chemistry and Industry*, March 2, 1923).

Field-Drainage Works as a Remedy for Unemployment in Country Districts of Great Britain. — The Ministry of Agriculture of Great-Britain passed on March 9, 1923, 469 schemes for field drainage in various districts throughout the country, as well as 110 schemes for water-supply, which should contribute to the decrease in unemployment in rural districts. On February 24, over 6000 men were engaged in these works.

The Small Land-Holding in Great Britain. — In accordance with the "Land Settlement Scheme", small land holdings have been handed over to ex-Service men and others in England and Wales 1422 holdings have already been assigned, but have not yet been taken possession of, as they are not cleared (*The Journal of the Ministry of Agriculture*, Vol XXX, No 1 London, 1923).

Exportation of Birds from Australia. — In the Congress of the Australasian Ornithological Union lately held at Adelaide, South Australia, the question of the exportation of live birds from Australia was discussed and the following resolutions passed: 1) No Australian birds shall be exported for gain, 2) No birds threatened by extinction shall be exported, 3) No birds shall be exported without proper inspection, 4) that an Office shall be established for the inspection of such birds as it is necessary to export, or that are to be exchanged for scientific, or instructive purposes. The Staff of this Office shall consist of two representatives of the Ornithological Union of Australasia, and in addition: a) one representative of the Universities and of the Scientific Societies of every State of Australia; b) a representative of the Natural History Society and of the Society for the Protection of Animals; d) one Museum representative for every State. (*The Avicultural Magazine*, Vol. 1, No. 3. London, 1923).

The Canadian National Poultry Record Association has been officially recognised by the Ministry of Agriculture of Canada. The object of this Association is to register all hens that fulfil the following conditions: are of pure breed and true to type — are free from disqualifications — have laid during one year, under the control of an official egg-laying competition, at least 200 eggs weighing not less than 2 oz. (*The Agricultural Gazette of Canada*, Vol. X, No. 2, p. 165 Ottawa, 1923).

Silk-Worm Rearing in Greece. — It is stated in the *Economiste d'Athènes*, Year 2, No. 38, p. 541, that the Greek Government, in assigning land to Armenian refugees, will choose by preference ground best adapted to silk-worm breeding, in order to establish, by the help of these fugitives, a large Greek sericultural industry.

New Italian Stock-Breeding Periodicals. — *La vedetta zootechnica*, Cremona, Editor Prof. TORREGIANI — *Il campo zootecnico e caseario* organ of the "Istituto pratico di zootecnica e caseificio M. Solari", Cuneo, Editor: Dott. GIVUARIO — *La nuova veterinaria*, a monthly scientific review, Bologna, Editor: Prof. Alessandro LANFRANCHI — *Il cavallo italiano*, Rome, dealing chiefly with Italian, Anglo-Oriental and Anglo-Arab riding-horses.

The "bambacella" of the Olive Tree in Tripolitania. — "R. Ufficio agrario" of Tripolitania has informed the International Institute of Agriculture in Rome that the "bambacella" (*Euphyllura olivina* Costa), has attacked the olive-yards of the Colony to a somewhat serious extent. This is mainly due to the South winds (Ghibli), being considerably later than usual and were unable to exercise their beneficial mechanical action which, in past years, had almost completely neutralised the action of the parasite, and made measures of control unnecessary.

Exportation of Eggs from Poland. — This amounted in 1922 to 2 500 000 dozen (as against 1 333 000 dozen in 1921). The eggs were mainly sent to England and Austria. By an arrangement entered into between the Polish Republic, Austria and Switzerland, the last two countries are to receive 10 % of the total number of eggs exported. (*Weather, Crops and Markets*, June 2, 1923).

Agrarian Bills of the Czecho-Slovakian Republic. — 1) *Bill for the abolition of fideicommissum*. The institution of fideicommissum dates in Czecho-Slovakia from 1763, although the first registrations date back to 1602 (fideicommissum of Lichtenstein). The object of this institution is to assure to a given family of the nobility an eminent social position and to reduce the number of large family country properties. According to the law of 1868, new fideicommissi can only be instituted by a special law. The new bill suggests the abolition of the fideicommissum and forbids the appointment of any other holders of the Office. Any person desirous of having the use of a fideicommissum must come to an agreement with three future claimants and with the Curator of the Fideicommissum as to the manner in which it is to be administered. The agreement has to be communicated to the Court dealing with these matters in order to have it ratified within 6 months. Should the parties fail to reach any agreement, the property

becomes the possession of the person who now enjoys it, and of the person who occupied the position of next legal heir.

2) *Bill for Encouraging and Protecting Plant Production*, The Czecho-Slovakian Ministry of Agriculture has drawn up a Bill for the protection of the crops which suffer much from diseases and pests. The following is a summary of its provisions. Selected plants are often crossed by the access of pollen from unselected plants cultivated in the neighbourhood of the Selection Stations. To avoid this the growing of plants capable of fertilising the selected individuals shall only be permitted within a certain distance, so as to afford protection to establishments engaged in the selection and improvement of agricultural plants.

Agriculturists cultivating and breeding selected seed in their farms pursuant to agreement with the Seed Selection Stations are obliged to use every precaution to prevent the original seeds from becoming contaminated

The injuries caused by plant and animal enemies to rye in Czecho-Slovakia have been estimated at 20 % of the production viz., at 1 800 000 quintals of the value of 271 millions of Czecho-Slovakian crowns, those to barley at 15 %, of the production, viz. 1350 000 crowns, those to wheat at 10 % (631 000 crowns), to potatoes at 30 % (20 million crowns), to sugar-beets 10 % (80 million crowns) Apart from the losses occasioned to fruit-cultivation and silviculture (especially by *Lymantria monacha*), the annual losses caused in Czecho-Slovakia by the vegetable and animal enemies of cultivated plants reach a total of 1 500 million crowns (Communicated by M ANTONIN PROKŠ, *Agricultural Engineer, Secretary of the Ministry of Agriculture, Prague*)

Work of the Ministry of Agriculture of the Republic of Czecho-Slovakia for the Improvement of Domestic Animals. — Hitherto, stock-breeding has been regulated in various ways in the different countries of the Czecho-Slovakian Republic The Ministry of Agriculture is now endeavouring to introduce swine, sheep and goats A bill allowing stockbreeding to be regulated according to the different condition of the Republic by means of the decrees of the Ministry of Agriculture has been laid before the Chamber of Deputies This law makes the use of selected male animals compulsory in stock-breeding Special Commissions will be entrusted with the choice of breeding animals The Communes are obliged by law to acquire, and keep at the public expense, select male animals for public Service. The Government is authorised to define the limits of the regions for the rearing of the different breeds

The Ministry of Agriculture is trying to remove the necessity for importing elected bulls by means of itself establishing dépôts (or entrusting them to capable breeders), where improved breeds of native cattle can be reared and their milk yield tested, and by the formation of cooperative societies, or grazing farms (*i. e.* farms with 80 % arable land and 20 % pasture) for the raising of young cattle

These farms are to be managed by the agricultural Cooperative Societies or the Chambers of Agriculture under the direction of the Ministry of Agriculture. Hitherto, there have been 8 grazing farms and 30 grazing cooperatives. The communal grazing grounds are very numerous. The Ministry

of Agriculture subsidises both the grazing farms and the grazing cooperatives, and is drawing up regulations for the stock-breeding industry : choice of animals, keeping herd-books, giving young animals to the breeders of improved stock etc. The last condition is necessary in order to obtain the State grants (Communicated by M. ANTONIN PROKES, *Agricultural Expert, Ministry of Agriculture, Prague*)

ORIGINAL ARTICLES

THE ORGANISATION OF THE CAMPAIGN AGAINST LOCUSTS IN FRENCH WEST AFRICA

(Official Communication)

The International Convention for the Organisation of Locust Control of October 31, 1920, of which the General Government of French West Africa is a signatory, was followed by a North-African agreement entered into, in accordance with Article 3 of the said Convention, between Egypt, Tripolitania, Tunisia, Morocco, Algeria and French West Africa. This agreement has served as a basis for the organisation in French West Africa of an Information Service under the conditions suggested by the General Government of Algeria which had initiated the movement.

The Service consists of a close network of observation posts established in Senegal, Mauritania, the Sudan, the Upper Volta and the Niger from which information is transmitted to the Service for the Protection of Crops of Algeria by means of the General Service of Agricultural Inspection at Dakar.

The work of the observation posts has been defined in each Colony by circulars.

In addition, the Administrators of the various districts of the Colonies have been supplied with special instructions as to the best means of co-operating in the destruction of Acridiidae.

INFORMATION COLLECTED.

Enquiry of 1919. — The locust question has always engaged the attention of the General Government of French West Africa, and in 1919, it was decided to institute a general enquiry throughout all the Colonies of the Union in order to obtain as concise and accurate information as possible respecting the migrations and life

of the insects, to serve as a guide for measures to be taken to control these pests. The data forwarded were as follows :

MAURITANIA. — Years of the Invasions. — Throughout the greater part of this territory, the locusts make their appearance every year, although their presence was reported for the first time in 1910 at Kiffa, and in 1914 at M'Bout. In Trarza, according to Sheikh Sidia, the locusts regularly appear for seven consecutive years and afterwards are absent for the same period of time ; 1919 should be the end of one period of invasion.

Time of Year at which the Invasions Occur.

Generally the advent of the locust coincides with the rainy season (June-July), and the swarms continue to arrive until the winter-season (October). At M' Bout, Kiffa, Chinguetti and Atar, invasions have only been recorded in September and October.

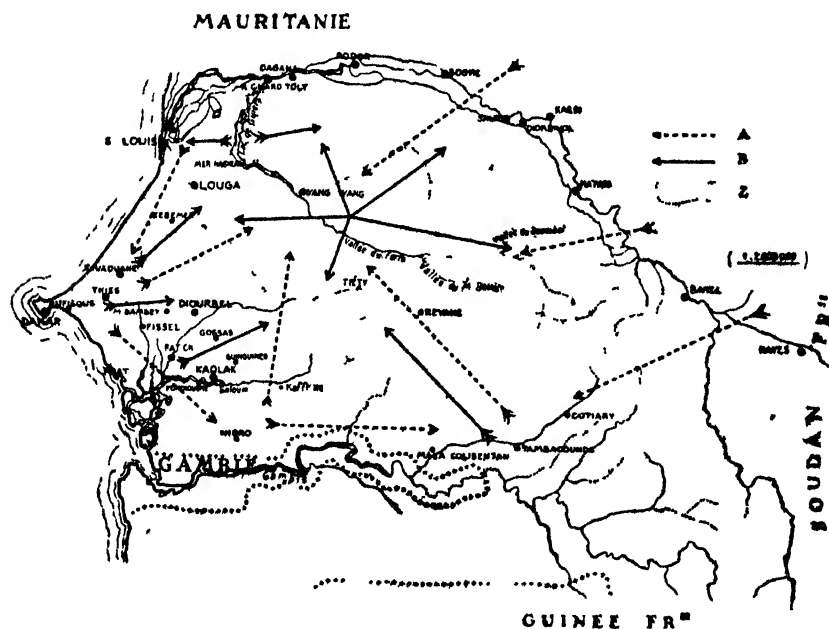


FIG 91. — Invasion of Locusts in Senegal

Direction of Flight 1907 1917		Season:	
A =	Flight of 1st generation locusts	1st generation .	2nd generation
B =	Flight of 2nd generation locusts.	January-March	May-June
Z =	Areas usually invaded for assembling and egg laying	June-July	November-December

Direction of the Flight. — The general direction of the flight of locust swarms is N-E, S-W, though sometimes it is N-S. In Gorgol (Kaedi), the insects fly from West to East; in Adrar, they go from South to North, while at Port-Étienne they direct their course from the interior of the country to the sea in which many of the locusts are drowned.

Places selected for oviposition. — The locusts have been found to lay their eggs in all the districts except Assaba (M' Bout). Any soils are suitable for the purpose, but the insects show a preference for damp sand. The eggs are laid as soon as the first rains begin.

Return flights. — Returning swarms have been observed frequently in the different districts, and would appear to be entirely composed of pink insects in some cases, though in others, the two varieties, the yellow and the pink, occur.

The adult form and to a still greater extent the nymphs, do considerable damage to the crops and to the vegetation generally.

The destruction of the winged insects is a very difficult matter. The natives scare the locusts from their fields by shouting and making as much noise as possible with instruments and any object at hand, but they only succeed in frightening away some of the smaller swarms.

The nymphs are controlled by digging trenches in front of their serried ranks and burying the insects as they fall in. Unfortunately, most of the locusts are hatched in the vast uninhabited tracts of Mauritania, so that the measures taken at some isolated spots do little to decrease the danger of invasion.

SENEGAL. — In 1907, an invasion of locusts took place here and the enquiry made at the time is the first documentary evidence of any value dealing with this subject.

From the information collected it would appear that the earliest invasion occurred at Bakel in 1853, but not until 1892, was there any correlation found in the data furnished by the natives. From the latter source we obtain the following information :

Years	Districts Invaded
1892.	Bakel, Matam, Sine-Saloum.
1893.	Casamance.
1894.	Podor.
1895.	Casamance.
1899.	Podor.

Years —	Districts Invaded —
1900.	Bakel, Matam, Podor, Dagana, Nianiouli.
1901.	Casamance and Podor.
1902.	Casamance.
1903.	Casamance.
1904.	Podor.
1906.	Casamance, Podor, Dagana, Tivaouane, Sine-Salu.
1907.	Casamance, Bakel, Matam, Saldé, Podor, Dagana, Louga, Sine-Saloum.
1908.	Saldé, Podor, Louga, Thiès.
1915.	Podor, Dagana, Louga, Tivaouane, Thiès, Diourbel, Sine-Saloum, Nianiouli.
1916.	Matam, Saldé, Podor, Dagana, Louga, Tivaouane, Thiès, Diourbel, Sine-Saloum.
1917.	Bakel, Matam, Saldé, Dagana, Louga, Tivaouane, Diourbel, Sine-Saloum.
1918.	Podor, Dagana, Louga, Tivaouane, Thiès, Sine-Saloum, Upper-Gambia.

The directions of flight given in the replies to the 1919 enquiry were as follows

Invasion 1906-1907.

Date —	Locality —	Direction —
February 1906 . . .	Dagana	East
August 1906 . . .	Podor	W. N. W.
November 1906 . . .	Sine-Saloum . . .	North
November 1906 . . .	Tivaouane	East
January 1907 . . .	Louga	East
March 1907 . . .	Sine-Saloum . . .	N. W.
April 1907 . . .	Saldé	N. W.
May 1907 . . .	Bakel	East
May 1907 . . .	Batam	North-East
May 1907 . . .	Sine-Saloum . . .	South

1908 Invasion.

<u>Date</u>	<u>Locality</u>	<u>Direction</u>
April	Saldé	South
June	Matam	N. W.
September	Podor	N. N. W.
»	Dagana	North
»	Louga	N. N. E.
»	Thiès	N. N. E.
»	Tivaouene	N. N. E.
October	»	N. N. E.
November	»	N. N. E.
»	Thiès	N. E.

The invasions of locusts were not afterwards recorded until 1915-1916; the swarms were very numerous both in 1917 and 1918. The course taken by the insects is given in the appended map.

In 1915-1916, numerous swarms of locusts arrived from the North and North-East; they crossed Senegal at various points between Bakel and Dagana directing their flight to the Ferlo and Djoloff, some taking the direct route past Matam and Louga and the others skirting Louga as far as the Gambia and turning up afterwards towards the Ferlo.

At the end of the wintering season, swarms of young locusts invaded the whole Colony being carried towards the North by the dominant winds. They were recorded everywhere from Sine-Saloum to the river which they crossed and then directed their flight again to the North-East.

In 1917, their course was observed to be almost the same :

<u>Month</u>	<u>Localities</u>	<u>Direction</u>
January 1917 . . .	Thiès (red locusts) . . .	N. W.
February	» (») . . .	South
March	Sine-Saloum	S. W.
June	Dagana (yellow locusts) .	N. W.
August	Louga	N. and N. W.
September	Louga	N. W.

Month	Localities	Direction
September.	Tivaouane	N. E.
»	Thiès	»
»	Matam.	North
»	Saldé	»
October	Dagana	»
November	Bakel	East
»	Sine-Saloum	S. W.
December	»	»

In 1918.

January	Dagana (red locusts). . .	N. W.-S. S.
July	Dagana (young locusts) .	N. W.-S. E.
»	Baol.	N. W.-S. E.
August	Louga	N. W.-S. E.
»	Thiès	N. S.
»	Tivaouene	N. N. W.-S. S. E.
October	Podor (red locusts) . .	W. E.-N. N. E.
»	Dagana (» ») . .	W. E.
December	Upper Gambia	N. S.

(See fig. 91, page 824).

SUDAN. — *Dates of Invasion.* — Great damage has been done by "*Sauterelles pélerines*" (*Schistocerca tatarica*) at different localities in the Colony every year since 1897 inclusive, except in 1903-1904, 1905, 1911-1912 and 1913.

The *Schistocerca* nymph does the most injury, but from 1899 to 1902, a great deal of mischief was also caused by the grey locust (*Pachytylus migratoroides*).

Season of Invasion and Direction of Flight.

— The *Schistocerca* nymphs arrive at Hodh from the regions of the Sahara in the red, or yellow, stage, in June, or July, as soon as the rains begin. The insects mate and lay their eggs shortly after arrival and the larvae hatch out and spread over the Sahara zone in every direction.

If the number of locusts is very large, as it was from 1906 to 1909 inclusive, and again from 1914 to 1918 inclusive, the swarms reach the districts of Kayes-Nioro and Nara between July and October.

The sandy character of the soil in the Sahara zone, together with the moderate rainfall, appear to be favourable to the spread of the *Schistocerca* nymphs, whereas their progress is arrested in the Sudan district, along a line that varies according to the season, by the heavy rainfall and excessive damp.

From the Sahel, the insect normally extends its ravages eastward, and either crosses the bend of the Niger, or follows the valley of that river. These nymphs swarm in the Gao district from August to September, or from January to February, and at the latter season, some of the bands resume their flight towards the Sahara by the way of Wady Telemsi and Adrar Iforas, while the others continue their course in the direction of the Tchad.

During the first part of the dry season, the swarms sometimes make their way far towards the south, but they then do little harm to the crops, either because the harvest is ended, or because the wild vegetation provides them with sufficient food. As soon as the soil becomes too dry and hard to allow of oviposition, which occurs about December, the insects again taken wing towards the north.

Localities for Egg-Laying. — The locust has only been observed to lay normally in the Sahalian zone and the districts of Nema, Nioro, Niafunké, Goudam, Timbuctoo and Gao.

The swarms alight at night, for this is the time for oviposition. Incubation lasts from two to three weeks, and the insect is able to fly in forty to sixty days after it is hatched.

Return Flights. — Swarms of locusts proceeding Northwards are seen in Hodh from October to February.

Pachytylus migratorioides, which is more feared in some of the southern districts than *Schistocerca tatarica*, has not been reported since 1902. According to local tradition the swarms of this Acridian start from the Manding Plateau.

NIGER. — The Dates of the Invasion. — All the documents consulted, and the data given on this subject by the natives agree that, until towards the end of last century there had never been, throughout the whole territory, any large invasions of locusts that had destroyed the crops. Every year, a small black locust used to come from the East in October, but it flew over the millet fields without touching the grain and alighted on trees, date-palms by preference, and devoured the leaves. This species has now disappeared.

About thirty years ago, probably in 1890, the first invasion of

grey locusts with pinkish-yellow abdomens took place. They came both from the North and the East, and over ran the whole territory, doing considerable damage. Since that time, no single year has passed without swarms of locusts, which while they were insignificant in size in the vicinity of the Niger, the district of Niamey being relatively little attacked, increased in dimensions and density as they passed eastwards.

Season and Direction of the Invasions. — As regards the time and direction of the invasions, it seems that the Military Territory of the Niger may be divided into three well-defined zones where the season of the arrival of the locusts and the course of their flight are quite different. These zones are

a) In the East, the region included between the Territory of Tchad and a N-S line following approximately the meridian of the 10th degree of east longitude.

b) In the West, a strip of territory about 100 km. wide and parallel to the river.

c) In the Centre, the region included between the two preceding zones and forming the greater part of the Territory.

A. — Eastern Region. — The swarms that reach this district are the largest in the Territory. They arrive during the winter and generally come from the East. Thus, in Bilma, they are reported in January as coming from the East, or occasionally from the North. Most of the swarms arriving at N'Guigmi come from the East in November, although a few smaller bands have been reported in July. Numerous swarms from the Tchad invade Mainé-Soros every winter, one especially large swarm was recorded in February 19, 1919.

All these bands of locusts interrupt their flight towards the West when they reach the neighbourhood of the 10th meridian, or more exactly on the western limit of the vegetation of the Oases, which traces a curve towards the West as it passes towards the cultivated regions of the South. No swarm has ever been reported at this season flying in the direction of Gouré, or northwards to Agadez. We shall, however, meet with these locusts again in the paragraphs dealing with egg-laying and the return flights of the insects.

B. — Western Region. — The district of Niamey, which lies on the extreme limit of the territory, is the goal of many small swarms that annually make their way thither from every quarter in February and March. Those swarms that are composed

of grey locusts with pink abdomens, arrive at a time when there are no crops, or grass, to be found, so the insects gradually disperse in all directions and disappear as soon as the heat sets in without reforming into swarms. Thus from the point of view of " migrations ", the river district clearly does not belong to the same category as the Eastern district of the territory.

The invasion of 1890 was especially destructive in the region of Niamey. It took place in May, for the first rains hatched out the eggs that had been laid by the locusts in the sand, and for six or seven years, the country suffered from fresh broods of innumerable nymphs that appeared annually. At last, however, the pests disappeared and from that time, the riverine district was free from the nymphs and only troubled by the swarms of adult insects mentioned above.

Central Region. — This region as we have delimited it, forms the largest part of the Territory, and suffers from two annual invasions of locusts one occurring before, and the other after, the rainy season.

The first swarms arrive in May and June ; they come from the North-West of Azaouak, a district North-West of the Tahoua-Agades line. Some of the swarms stop between Tessaous and Madaoua (to these we shall return in the paragraph dealing with oviposition), but the larger number continue their course to Tassaoua and then turn due East by way of Zinder. This invasion is short, for the locusts (which are grey with pink or light yellow abdomens) only stay one or two days and mate, since they find nothing but the leaves of the trees to eat. In the neighbourhood of Gouré, a few bands turn aside to the South-East in the direction of Mainé-Soro and Nigeria, but most of the swarms fly North-East to the limits of the vegetation of the Oasis on the 10° of East longitude where the bands reported from Bilma and N'Guigmi have already halted three months earlier and to which region they seem to be irresistably attracted.

The second invasion takes place immediately after the end of the rainy season and follows an exactly opposite course to that adopted by the preceding invasion, the swarms starting from the edges of the oases where the first-comers had stayed their flight. It is, however, a new invasion, for the locusts composing these swarms are generally smaller than those that passed three months earlier and most of them have brilliant pink, almost red, abdomens, so that

it can be no question of the returning bands of the first invaders. The swarms reach Gouré in September, and are seen in October, at Zinder and Tessaoua.

This second invasion is much the most dreaded, for at this season an uninterrupted stretch of crops, mostly of ripe millet, extends from the Tchad to the Niger. The locusts which fly in such dense clouds as sometimes to give the impression that an eclipse of the sun is in progress, alight on the millet fields and devour an enormous amount of grain as compared with their size. The natives declare that many of the insects fall victims to their greediness and are found clinging to the ears of millet, dead from over-feeding.

West of Tessaoua, the swarms take their flight in two directions, but finally meet at the same point. Some of them turn towards the north arriving at Agades in October, and on coming into contact of the Massif of the Air, sheer off westward towards the Azaouak. The others continue their westerly course past Madoua and Tahoua, and when they arrive at the Massif of the Ader, fly north in the direction of Azaouak.

The region of Agades and the Massif of the Air adjoin the central region which is annually exposed to the two invasions, to which allusion has just been made. The neighbourhood of Agades escapes the first invasion, for the locusts pass to the South-West, but on the other hand, at the time of the second invasion, many nymphs that have hatched out a few months previously in the district of Air and have gradually descended the southern slopes of the Massif, ravage the meagre, sparsely-sown crops of that area. These swarms meet the others returning southwards, mingle with them, and disappear with them in Azaouak.

The latter place thus appears to be a meeting centre at the end of October and early in November, for all the swarms of locusts in the Central region on their way east after the rains. What becomes of these bands? They ought to be met with at Hogger. If they go North-west, they would be reported in winter from the district of Gao and Adrer or Iforas; perhaps some of the flocks continue their course to the west and south-west, in which case, the locusts found in February at Niamey may belong to these swarms that have been weakened and reduced in numbers by their long winter flight.

The natives, however, assert, without adducing any proofs that these insects pass the winter in Azaouak where the rocky plateau pierced with numerous deep caves would afford them shelter

from the cold. If this be the case, these locusts may well form the swarms which take part in the first invasion and descend again next year, in May towards Zinder, but we possess no certain data in confirmation of this hypothesis. The problem can only be solved by seeing these bands join forces with the migrating swarms found in the Timbuctoo district and on the Hoggar massif.

Oviposition. — The best known localities of oviposition in the Territory, and certainly those where the locusts lay most eggs, are situated on the western limit of the vegetation of the Oases between the line running North and South from Bilma to N'Guigmi and the meridian of the 10th degree of East longitude. The swarms from Bilma and N'Guigmi come hither in January and February to lay their eggs and are successively followed by those from Zinder and Gouré which, however, do not arrive until June.

Another favourite place for oviposition is the district lying between Madaoua and Tessaoua on the northern limit of the cultivated land. Here, some of the swarms stop in May on their flight from Azaouak.

A third area of oviposition has been also reported in the Air massif, but nothing is known as to the origin of the swarms that frequent it.

It is generally assumed that the first rains make the eggs hatch out. According to the natives, the eggs may remain for two years in the sand if there is no rain to moisten them. A fortnight after heavy rain, the ground is covered with countless nymphs that have emerged from the egg-clusters. Three weeks subsequently to their appearance on the surface of the soil, the insects are able to jump short distances, and a week later, they can fly a little. After another fortnight they are capable of undertaking long flights.

There is certainly one exception to the general rule according to which the action of rain is necessary for the hatching of the locusts' eggs. In the Oasis of Bilma, it hardly ever rains, indeed, rainless periods lasting several years almost invariably occur, yet it is to this very region, situated on the line where the cultivated land borders on the desert, that the largest numbers of locust swarms come to lay their eggs, while the nymphs hatch out every year and wend their way southwards. This apparent anomaly may possibly be explained as follows :

At the base of the rocky cliffs forming the eastern boundary of the region in question, there flows a subterranean stream which

comes from the north and seems to go past Bilma and Agadez in the direction of the Tchad. Although this stream runs at a depth of one metre at Agades, it is almost on a level with the ground at Bilma where the locusts deposit their eggs. In June, the sand is saturated with water, and as it gradually becomes heated by the sun, so much water is given off by evaporation that the few centimetres of sand between the stream and the air, in which stratum the eggs have been deposited, becomes damp and therefore the eggs readily hatch out. Thus, the same result is obtained as from the rain, but the moisture reaches the eggs from a different direction.

Return Flights. — The returning swarms mentioned by the district Governors are few in number.

It has been reported from Bilma that some of the swarms coming from the east in January returned to that quarter in February, but nothing was said as to whether oviposition has been effected in a normal manner. It was, however, stated that the number of these returning bands is very small in comparison with that of the outward bound swarms.

At Agades, some of those locusts coming from the north which we have already spoken of, are occasionally seen in October to unite together into large swarms and direct their course to Azaouak. These returning locusts are so thin that they are worth little as an article of food; the expedition to Ténéré did not prove a success and for the above reason was a great disappointment to the natives.

What part do the return swarms play in the the second invasion that crosses the central region of the Territory? This is most difficult to determine, but it is certainly very insignificant since the greater number of the locusts that come subsequently to the first invasion, die after they have laid their eggs on the soil, which is impregnated with salt, or natron, for the scanty vegetation offers the locusts no sustenance, and the ground is sometimes covered with their dead bodies. The few individuals that survive go back probably with the nymphs, but there are no data showing the number that actually survive.

Further, it may well be that the many large grey locusts which we mentioned above as being found dead, clinging to the millet ears, were old insects that had undertaken the task of guiding the young swarms and had succumbed to age, and not to greediness.

If this explanation is correct, and it is true that the locusts winter in Azaouak, we could now trace out the complete cycle of which

we spoke earlier the insects hatch near Bilmé in the summer, migrate towards the West in the autumn, winter in Azaouak returning in the beginning of summer to the neighbourhood of their hatching-place where they propagate their species and then die. In this case, they would traverse a thousand kilometres.

But even if these suggestions are taken as proved, we should only have a partial solution of the problem for the whole question of the migrations remains almost untouched. What is the complete



FIG 92.

I-XI = months of year
H = wintering
P = laying of eggs

course of the swarms reaching Bilma and N'Guigmi in winter from the East. Whence come the locusts that lay their eggs in Air, and those that arrive at Niamey from all directions in February?

As we foreshadowed at the beginning of this article, nothing but a thorough study of the Acrididi, carried out over the whole of Africa, would render it possible to fix the principles and determine the general rules governing the migrations of locusts. This paper can only form a small contribution to the study of the question (see fig. 92). The information collected is, however, a valuable help in the attainment of the object aimed at by each of the Governments forming a party to the agreement for the control of locusts.

Observations from 1922-1923. — The telegraphic information transmitted to Algiers arrived in the following chronological order :

May	31, 1922,	swarm reported from M' Bout.			
November	2, 1922,	swarm reported from M' Bout.			
»	24	»	»	»	Nioro coming from the south-east and flying north-east.
»	25	»	»	»	Niamey coming from the east and heading south.
December	3	»	»	»	Néma (west of this place)
»	4	»	»	»	Niamey coming from the south-east and going north-west.
»	31	»	»	»	Tillabéry coming from the east and flying north.
January	1, 1923	»	»	»	Tillabéry coming from the east and going south
»	2	»	»	»	Niamey, coming from N. N W and going south-east.
»	12	»	»	»	Kiffa.
»	15	»	»	»	Tillabéry coming from the east and flying west.
»	21	»	»	»	Kiffa, 2 km. to the north.
February	12	»	»	»	72 km. W. S. W. of Nara a portion of a large swarm reported from Ngalabougo.
March	5	»	»	»	Niamey.
»	11	»	»	»	El-Oualadji.
»	20	»	»	»	Barouéli coming from North-east and flying eastward.
»	29	»	»	»	Dogondoutchi.

April	6	1922,	swarm	reported	from	Barouéli	and	El-Oualadji.
May	5	»	»	»	»	Dogondoutchi.		
»	26	»	»	»	»	Niamey passing north.		
»	27	»	»	»	»	Niamey passing north-east.		
»	28	»	»	»	»	Niamey passing east.		

GENERAL GOVERNMENT OF FRENCH W. AFRICA

Inspector General of Agriculture

FURTHER PROGRESS IN THE IMPROVEMENT OF ARABLE LAND

As a result of the development of agronomic science and of the progress made in the experimental field of plant physiology, many new ideas as to the best means of increasing agricultural production have gradually arisen. At the present time, it is certain that the increase in the living vegetable matter of our agricultural products can only be attained by a thorough knowledge of the biochemical nature of the soil and of the chemical energy of the plant cell. The problem is of paramount and world-wide importance, but in France especially it would be possible to increase the crops of wheat, beetroots and potatoes, an immense advantage to the national revenue, since the agricultural products of that country are valued at thousands of millions of francs.

The distinguished scientists of the preceding century gave their attention to soil physics and chemistry, but the more recent revelations of science have shown that the soil is inhabited by various organisms which play a large part in plant nutrition. It was PASTEUR who, last century, drew attention to the great importance of the micro-organisms in the soil, but unfortunately, the signal service rendered by his genius in this direction was not sufficiently recognised.

The work of the soil bacteria was only realised when the great discoveries of the celebrated scientist BERTHELOT, resulting from his first experiments at Meudon in the assimilation of free nitrogen, and the studies made by WINOGRADSKI, DUCLAUX, MAZÉ, LAURENT, SCHLOESING, BEIJERINK and others on the circulation of nitrogen in the soil threw a new light on the important function of these indispensable microorganisms.

HELLRIEGEL and WILFAHRTS' discovery of the synergy of the bacteria present in leguminosae and of algae, and the exhaustive studies of HILTNER and NOBEL suddenly enlarged our knowledge of the facts connected with the assimilation of atmospheric nitrogen.

CARON, a farmer of Ellenbech, had however been engaged in working out the problem of the importance of soil bacteria as factors

effecting the vital processes of plant life, and the fruit of his long labours was the discovery that arable land could be inoculated with soil bacteria capable of assimilating atmospheric nitrogen. He adopted this inoculation process in the case of fields to be sown with wheat.

The writer of the present article, on his return from the Pasteur Institute thirty years ago, gave much attention to this question, and strongly advocated the idea of inoculating arable soil, as is shown by his published works on this subject and the numerous lectures given at Paris, Nantes, Grenoble, Rome, Berlin, Vienna and Cracow.

Unfortunately, but little heed was paid to the ideas of PASTEUR and of BERTHELOT, indeed, it is only after many years of experiment in many countries, especially in America, that it has been realised how important is the work of these small living organisms which, by the changes they produce in substances and in energy, exert such an enormous influence upon the fertility of the land as to make it impossible to disregard their activity.

No agriculturist can now deny that the work of these bacteria is one of the most important factors in determining the fertility of the soil. We, ourselves, have found the weight of the bacteria present in a soil layer of 40 cm. extending over 1 hectare of fertile arable land to be from 200 to 400 kg, while that of the other living organisms ranged from 800 to 1000 kg.

The following groups of organisms live in arable land and are very active agents in promoting its fertility

- | | |
|-----------------|------------------|
| 1) bacteria | 8) enchytracides |
| 2) fungi | 9) tardigrades |
| 3) algae | 10) spiders |
| 4) protozoa | 11) insects |
| 5) rotifers | 12) molluscs |
| 6) oligochaetes | 13) mammals. |
| 7) nematodes | |

All these organisms that inhabit the soil require for their support oxygen, hydrogen, carbon, nitrogen, phosphorus, sulphur, chlorine, potassium, sodium, lime, magnesium, aluminium, iron and manganese. In the case of the heterotropic forms, it is necessary that the carbon should be present in an organic form, and for the same reason,

organic substances are of paramount importance to the existence of the bacteria and fungi of the soil.

The oxygen and water in the soil play a special part in connection with all the living organisms, which have frequently almost to contend with one another in order to secure the amount of water necessary to their well-being.

Since no organisms can live without water, the determination of the water capacity as well as of the air capacity of a soil is the basis of biochemical experiment.

In order to know exactly the proportions of the aerobic and anaerobic organisms, it is necessary to determine the amount of carbon dioxide and oxygen present in the soil.

Oxygen is indispensable to metabolism and to the functioning of the radicle system of the plant. If the oxygen content of the soil falls, however, the processes of assimilation continue normally, even when the amount of oxygen is small, and intermolecular respiration may take place in the radicle system.

Further, the reaction of the soil greatly influences the biological processes occurring in it, hence this factor deserves serious attention, not only from the purely physiological standpoint, but also from the phytopathological point of view.

The hydrogen-ion concentration of a soil has a great influence upon its chemical and biological absorption. Neutral and alkaline soils absorb nutritive substances more readily than those with an acid reaction. In order to judge of the biochemical processes in progress in a soil, the colloidal substances present must be determined. The value that is of most interest to the biochemist is the degree of dispersion which determines the area of the active surface. Biologically speaking, the colloidal content is the most decisive factor, and the colonies of bacteria must not only be taken into account, but also other groups of organisms. Of these the principal are the actinomycetes, and different species of fungi and algae. The quantity of micro-organisms varies considerably according to the kind of soil and the extent to which it has been worked. By far the larger number are found in a layer varying in depth from 10 to 25 cm.; below 40 cm., their number decreases rapidly, and at a still greater depth, there are relatively few.

In order to better illustrate this, the number of micro-organisms is given which were found in 1 gm. of dry soil taken from a layer 10 to 20 cm. deep.

In a rye field	30 to	43 million
In an oat field ,	28 "	45 "
In a barley field	42 "	58 "
In a beet field	70 "	90 "
In a potato field	42 "	45 "
In a clover field	72 "	86 "
In a lucerne field	80 "	120 "
In good garden mould		130 "

It must, however, be mentioned that the above figures refer to soil samples taken after the crops had been carried at the beginning of August. The data obtained show that the largest quantities of bacteria occurred in the fields where sugar-beets and clover, or lucerne, had been grown and in good garden mould. Most of them were the rod-like forms, cocci being rarer. The number of fungi found was somewhat small. Ordinary forest soil contains fewer micro-organisms, 15 to 26 million being present in 1 gm. of a dry sample taken from a layer 20 cm. in depth, and only 5 to 9 million in the case of acid soil.

The composition of the microflora, of which nothing has been known until now, has a great effect in maintaining the fertility of the soil.

All these micro-organisms require, in addition to oxygen and water, certain quantities of nitrogen, carbon, phosphorus, potassium, magnesium, iron, and sometimes of aluminium, in easily assimilable forms.

According to our experiments, they contain 40 to 50 % of carbon which would seem to show that they need larger amounts of carbon than of the other substances.

Different kinds of micro-organisms find their home in the soil, the following groups of bacteria being represented :

1) bacteria which, like green plants, need not be supplied with sources of carbon dioxide or of nitrogen. These autotrophic bacteria can obtain for themselves carbohydrates, as well as albuminoid substances, carbon dioxide and inorganic salts ;

2) bacteria needing sources of organic carbon, but independent of nitrogenous substances, as they can obtain all the latter they require in the presence of carbon, atmospheric nitrogen, nitric and ammoniacal nitrogen ;

3) bacteria which, like animals, require sources of organic car-

bon, and obtain their nitrogen from nitrogenous compounds. They cannot produce inorganic substances, nor effect the synthesis of carbohydrates, neither can they form the albuminoids present in living cells.

Bacteria and fungi find in the organic matters of the soil :

- 1) substances for the building up of new living matter ;
- 2) the substances they require for respiration.

The amount of carbon dioxide liberated in 1 kg. of soil at the same temperature and moisture content and with free circulation of air, affords an indication of the relative respiration intensity of the autotrophic and heterotrophic micro-organisms present in different soils. The quantity of carbon dioxide given out under these conditions shows the vital energy of the bacteria and their power of breaking up the organic substances in the soil.

In organic matter, the bacteria not only find a source of the energy necessary for respiration, but also a rich store of carbon and nitrogen, for the formation of new living matter.

The writer was the first to discover the origin of the large amount of carbon dioxide in the soil and its great importance. This he did as early as 1905, as a result of numerous experiments. He also laid stress upon the large quantity of carbon dioxide produced by the soil bacteria.

For several years, the writer has studied the intensity of the respiration process in the auto and heterotrophic micro-organisms living in the soils of our fields, meadows, forests and gardens. This work has shown the intensity of the process to vary enormously and to depend upon the following factors :

- 1) the air and water capacity of the soil,
- 2) number of active autotrophic and heterotrophic forms,
- 3) intensity of oxidation and of breaking-down processes,
- 4) soils power of splitting up cellulose,
- 5) chemical reaction of soil,
- 6) mechanical cultivation,
- 7) kind of fertiliser used,
- 8) species of plants grown.

The writer gives the following numerical data obtained in the course of his long investigations, which will serve to show how the respiration intensity of micro-organisms in the soil is a criterion of the fertility of the land.

The respiration intensity of the autotrophic and heterotrophic micro-organisms present in 1 kg. of soil containing 20 % of water, and kept under aerobic conditions for 24 hours at 20°C. has a certain relation to the bacteria in the soil.

The following amounts of carbon dioxide have been found in 1 kg. of dry soil :

Average in soil free from organic substances	8.14 mgm.
Meadow soils.	10.16 "
Forest soils poor in organic matter	9.12 "
Forest soils rich in organic matter	16.26 "
Poor rye and oats soils	19.25 "
Good rye and oats soils	30.36 "
Good wheat soils	30.48 "
Good clover soils	53.60 "
Good sugar-beet soils	56.68 "
Good garden mould	62.75 "

Carbon dioxide production falls rapidly as the depth of the soil increases, thus only traces of the CO₂ resulting from respiration are met with 50 cm. below the surface. The liberation of a large amount of this gas is evidence, not only of the presence in the soil of much easily-destroyed organic matter, but also of the presence of actively working bacteria.

It should be remembered that these quantities of carbon dioxide given off by respiration in 24 hours represent the average for 20 days.

Distinct differences can be detected in the intensity of the respiration of the soil micro-organisms. These variations depend, as we have seen, on certain factors, and especially upon the number, kind, and activity of the bacteria, as well as upon the nature of the organic substances in the soil.

Supposing that the micro-organisms in 1 kg. of arable soil from a layer 26 cm. deep were only to produce 30 mgm. of carbon dioxide in 24 hours, the amount of this gas evolved by the micro-organisms in a mass of clayey soil weighing 5 000 000 kg. (the average weight of a layer 36 cm. deep spread over 1 hectare), would be 150 kg. per day which, if we only reckon at 200 days the time when the annual temperature attains the average of 15°C., would mean a liberation of 15 000 000 litres of CO₂ every year. The large quantities of this gas

expired by these bacteria help to form mellow soils, especially those of the more friable types. These figures leave no doubt as to the large part played by the respiration of micro-organisms in the formation of the carbon dioxide in the soil. One fact is especially interesting in this connection viz., the respiration of the micro-organisms present in a soil layer 10 to 30 cm. deep raises the temperature of the soil from 1° to 2°C. This is of the greatest importance, since such a rise in temperature represents 4 to 8 million calories per hectare.

In soil that has been altered to this extent, the carbon dioxide absorbed by the groundwater transforms the bi- tri- and tetraphosphates slowly, but surely, into water-soluble phosphoric acid.

It is also very necessary that the cations should be changed in the soil into bicarbonates ; in the formation of the latter is to be found the true importance of the above-mentioned carbon dioxide problem.

These bi-carbonates also form nutritive substances which promote the metabolism of the plants, also, they are easily absorbed by the root system, especially in the presence of carbon dioxide and are carried to the organs containing chlorophyll.

The plant finds in the soil, not only biogenetic elements like potassium, calcium, magnesium, iron and aluminium in the form of bicarbonate, but also carbon. Green plants assimilate carbon dioxide from the atmosphere by means of their aerial organs supplied with chlorophyll, while by the agency of their roots, they can obtain carbon from the bicarbonates of the soil thus, considerably increasing the chlorophyll function, raising it as much as 70 to 160 %, as we have found.

If the pressure of the air changes, the temperature increases, and the soil air containing carbon dioxide rises and comes in contact with lower surface of the leaves which is well provided with pores.

Low-growing plants are able to make more rapid and ready use of this stream of assimilating energy than trees. The old statement that green plants can obtain their necessary carbon only from the air is not true, for the roots are able to use the carbon present in an organic, or inorganic, form, in the soil, although the air still remains the chief sources of supply upon which the chlorophyll phenomena depend.

Our experiments have shown that when the CO_2 content of atmospheric air is 0.1 % the green mass of the crop is increased by organic synthesis. In ordinary air containing 0.04 % in volume of CO_2 , the whole weight of the beet rose to 120 gm. When the CO_2 content

reached 1 %, 2 % and 3 % the weight of the plant rose respectively to 224 gm., 258 gm. and 272 gm. Thus increasing the amount of CO_2 in the air progressively augments photosynthesis and metabolism, as well as contributing to the formation of fresh plant substance. The experiments were carried out for 38 days at the uniform temperature of 22°C . These facts prove that it is absolutely necessary to increase the production of carbon dioxide by bacteria.

Therefore we will investigate the soil on the one hand in order to determine the bacteria, or bacterial spores and the decomposing organic matter it contains, and on the other, with a view to determining the carbon dioxide production so as to have some basis upon which to work in trying to increase the output of CO_2 .

ORGANIC SYNTHESIS. — Carbon assimilation and the absorption of biological elements by the organisms of the sugar-beet proceed entirely according to certain mathematical laws. In the presence of different plant elements, and under ordinary conditions, the dry substance produced on 1 hectare of soil is 8000 kg. roots, and 4000 kg. leaves, or a total of 12 000 kg. of sugar-beets.

This dry matter includes 5.400 kg. of carbon. We found from our experiments that during the vegetative period, the organism of the beet that is to say, the roots and leaves, gives off 4 280 kg. of carbon in the form of carbon dioxide; therefore the sugar-beet assimilates, under the influence of the solar rays, 9 680 kg. of carbon in the form of atmospheric carbon dioxide. The photosynthesis can be decidedly increased by CO_2 and radioactivity.

In order to accomplish this, it is necessary for 44 million cubic metres to pass through the pores of the leaves. We can now have some idea of the dynamics of photosynthesis. If one of the elements of the plant has its physiological function lessened by a decrease in the energy of the solar rays, or a variation in the amount of heat, moisture etc., the whole process of photosynthesis is correspondingly depressed.

The phenomena of the assimilation of atmospheric carbon dioxide and of the biogenetic elements in the soil take place in relative proportion.

The reabsorption of the biogenetic elements of the soil is carried out according to certain mathematical laws: 9680 kg. of carbon are assimilated in relation with 168 kg. nitrogen (N), 220 kg. potassium (K_2O), and 66 kg. phosphoric acid (P_2O_5). All the mechanism for the synthesis of the materials used in the construction of

the plant organism is regulated according to the results of the assimilation of CO_2 from the atmosphere, because all the biogenetic elements have a certain relation to the carbon assimilated, and the reabsorption of the mineral elements of the soil depends upon the intensity of the photosynthetic process and upon the composition of the carbohydrates, fats and albuminoids. Herein lies the solution of the great problem of the increased yield observed in the sugar-beet. By the application to the soil of a large number of biogenetic elements, phosphorus, nitrogen, potassium etc., in the form of chemical fertilisers, we have already obtained the best results obtainable by this means. If we desire to produce a still higher yield and improve the quality of the crop, we must so arrange that the organism has at its disposal more carbon in the form of carbon dioxide and this can only be done by increasing the biological activity of the soil to the point of making one kg. of dry soil produce 100-130 mgm. of CO_2 in 24 hours. In fact, all the best sugar-beet soils are characterised by intense biological activity and large production of carbon dioxide.

By a series of continuous experiments, we have succeeded in supplying the soil with certain quantities of nitrogen, phosphorus and potassium under forms that will unite to make easily-decomposed organic combinations containing a larger number of active bacteria.

These compounds are, *nitrogenous humus* and *phosphatic humus*. The latter contains 13 to 14 % water-soluble phosphoric acid, a larger proportion of organic matter and about 2 thousand million active bacteria per gm. Phosphatic humus is made with natural, crushed phosphate.

Fortunately for France, she possesses large quantities of various kinds of natural phosphates that are easily disintegrated by biological action. The powdered phosphate is mixed with prepared peat which is subsequently inoculated with cultures of bacteria, those species being selected that are found upon the root of the sugar-beet. These bacteria are cultivated artificially, and the whole culture is inoculated into the prepared peat which is in a colloidal condition. The mixture is then left to ferment for 15 days. The phosphatic humus thus obtained has been used with marked success as a substitute for superphosphate. Nitrogenous humus is made with calcium cyanamide, which is transformed by the action of the enzyme urease into ammonium carbonate. In the presence of carbon dioxide, bicarbonate of ammonium is formed.

The percentage of the fertilising substances present in nitrogenous humus is as follows:

Ammoniacal nitrogen	8 : 10 %
Organic matter	25 : 30 %

Nearly one thousand million active bacteria are found in 1 gin.

Satisfactory experiments (to the total number of 320), have been made with this fertiliser at our State Experiment Station, as well as by the Agriculturists' Association of the Republic, the Brunn Regional Chambers of Agriculture, and at Prague. M. MAHNER (Councillor), M. SKARDE (engineer) and Dr. LIPSCHUTZ being chiefly interested in these tests. According to the published results, the crops were increased 55, 70 and 120 % by the application of 600 to 800 kg. of this biological fertiliser per hectare.

Nitrogenous and phosphatic humus have the same effect as dung and chemical fertilisers, but they produce higher yields. The bacteria of these humic fertilisers not only are more numerous than in dung, but they include species giving rise to a very beneficial fermentation action in the soil.

From all that has been said, it is clear that we actually have at hand the means of greatly increasing our agricultural crops, provided we keep in mind that free access of oxygen to the soil is necessary to insure proper fermentation.

In the experiments we have carried out with a soil that had been fertilised and inoculated with bacteria and was distinguished by great intensity of respiration, 1 kg. of air-dried soil producing up to 120 mgm of CO₂ in 24 hours we succeeded in obtaining the following yields per hectare: 500 to 680 qx. of roots containing 18.4 % of sugar, and 246 to 319 qx. of leaves.

JULES STOKLASA

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THE NEW NITROGENOUS FERTILISERS OF GREAT BRITAIN

The new nitrogenous fertilisers were already known and studied to some extent in Great Britain even before the War, but they played no very great part in practical farming. In this there were two reasons. In the first place the British farmer relies very largely on livestock to supply his land with nitrogen. A large number of cattle, sheep and pigs are kept, and over most of the country the system of husbandry centres round the animals.

Before the War the following were the approximate quantities and values of the nitrogenous manures consumed in the United Kingdom :

	Tons per annum	Estimated value per ann Pre War Prices
Farmyard Manure	37,000,000	£11,000,000
Nitrate of Soda	80,000	920,000
Sulphate of Ammonia	60,000	750,000
Cyanamide & Nitrate of Lime . . .	10,000	110,000

In addition to the farmyard manure large quantities of animal fertiliser are added annually to the soil by means of sheep folding, a common practice on loams, sandy and chalky soils, in which sheep are penned on the arable land, eat the growing crop and receive in addition quantities of corn and cake. No good estimate can be made of the quantities of nitrogen thus added, but in the aggregate they are considerable.

This factor continues to operate and it remains true that nitrogen reaches the farm soil largely through the animals.

A second cause of the comparatively small part played by the new nitrogenous fertilisers in British agriculture before the War lay in the fact that the country is well supplied with coal, and that various coal-using industries, notably Gas Works, Coke Ovens, Producer Gas Plants and others, take steps to recover the ammonia produced. To some extent the manufacture of sulphate of ammonia is only incidental to the main business. The manufacturers can hardly help making it; they cannot destroy the ammonia nor discharge it into the atmosphere or the streams without involving themselves in breaches of the Alkali and other Acts.

When industry is going at full pace the normal output of 400 000 tons or so per annum becomes almost automatic. The result is that a large quantity of sulphate of ammonia is available on the British market, far in excess of what the farmer now uses, or indeed is likely to use, in any time in which we are interested. Much was exported, very largely to the sugar-producing countries and to Japan for rice cultivation. The figures, in long tons, were :

	1909	1910	1911	1912	1913
Production	233 664	367 587	384 976	388 308	432 618
Export	162 300	284 976	292 000	287 000	325 000
Home consumption	71 700	87 000	85 500	90 000	97 000

The greater part of the home consumption was for agriculture, but not all as other industries, such as refrigerating, etc., took their share, though the demand for such purposes does not appear to be increasing. During the War the figures rose and they reached a maximum in 1917.

Since the War the production of sulphate of ammonia in this country has fallen off the figures are

	1917	1918	1919	1920
Production	458 617	432 551	397 513	418 881
Home consumption	384 000	404 500	285 500	233 500
Used for fertiliser	230 000	234 000	269 000	

With a home production of sulphate of ammonia so far ahead of home requirements, and remembering also that the nitrate of soda industry is well organised in Great Britain, it is obvious that new nitrogenous fertilisers are likely to have some difficulty in establishing themselves on the British market.

There are, however, certain directions in which the new are able to compete successfully with the older fertilisers, and these will be considered under the various heads.

Nitrate of Lime.

This substance has been tested at a large number of centres and has usually proved as effective as nitrate of soda ; sometimes the one and sometimes the other has proved the better, but on an average the difference has been slight. The most extensive trials are those started before the War. Some typical results have been as follows :—

	Mangolds							
	Midland Agricultural College, Derby 1915 (1)		Gloucester					Reading 1909 (4) strong loam
			Cirencester (2)		Calcareous soil (3)			
	light soil	heavy soil	1909	1910				
	t. cwt.	t. cwt.	t. cwt.	t. cwt.	t. cwt.	t. cwt.		
Nitrate of soda . . .	29 8 1/2	30 14	29 14	32 4	25 11	34 18		
Nitrate of lime . . .	28 8	30 4 1/2	32 5	30 3	25 11	35 1		
No nitrogenous top- dressing	20 10	25 18 1/2	23 14	28 0	21 19	23 3		

(1) *Midland Agricultural College, Derby, Reports* 1915, p 51, 1909 and 1910, p 33

(2) *Royal Agricultural College, Cirencester*, 1910.

(3) *Gloucester Country Council Reports*, 1909 and 1910, p 74 Table 1.

(4) *Reading University College, Department of Agriculture, Bulletin VII*, p. 11, 1909

	Potatoes				Barley		Wheat	
	(1)	(2)	(3)	(4)	Rothamsted		Rothamsted	
	Woburn 1909 Sandy loam	Devon Light soil	Jersey (5 cent-res)	Aberdeen Various centres 1907-1909	1909		1910	
	tonscwt	tonscwt	lb. per perch	tons cwt.	Grain bushels	Straw lbs	Grain bushels	Straw lbs
Nitrate of soda	15 9	10 15	221	9 5	48.1	3882	27.0	3760
Nitrate of lime . . .	15 6	10 7	228	9 6	46.2	4449	20.7	3618
No nitrogenous top-dressing	14 12	9 18	195	8 6	28.7	2619	15.4	1526

(1) *Journal of the Royal Agricultural Society, London* 1909, p 385

(2) *Devon Country Council Report*, 1907-1909, p 6

(3) *State of Jersey (USA) Field Experiments*, 1911, p 2

(4) *University of Aberdeen and North Scotland Leaflet* 9, p 2

In practice nitrate of lime still suffers somewhat from the disadvantage that it is apt to turn sticky in a moist atmosphere and that it must be conveyed in casks, a fact which necessarily adds to the cost of transport. Further, it is not suitable for the mixed or "compound" fertilisers which are very popular in Great Britain. It has, however, the great advantage of containing calcium in place of sodium, and is therefore of value in two sets of conditions in England.

1 — On heavy soils, since it does not cause the deflocculation and therefore the stickiness or "unkindliness" to use the farmers' phrase, which is often brought about by nitrate of soda.

2. — On soils deficient in lime, of which there are large areas in England, particularly in the west, where the calcium, small though it be in quantity, nevertheless proves of high value.

In the writer's view there is a distinct future for nitrate of lime in Great Britain, not in supplanting, but in supplementing, nitrate of soda and sulphate of ammonia.

Nitrate of Ammonia.

This substance became available for British farmers immediately the War was over, although in anticipation of the event the Rothamsted Experimental Station had made enquiries and experiments as to its probable value as fertiliser. Next to urea it is by far the most concentrated nitrogenous fertiliser on the market. When pure it contains 35 % of nitrogen, equivalent to 42 $\frac{1}{2}$ % of ammonia. Half of the nitrogen is in the form of nitrate which is immediately available for the needs of the crop, and the other half in the form of ammonia which comes into action somewhat later. Samples examined at Rothamsted have been about 96 % pure, the remainder being mainly moisture: in this case the nitrogen content is 33 $\frac{1}{2}$ %.

Further, as the ammonia is combined in the form of nitrate it has no exhausting effect on the lime in the soil, so that it can be used where there is a shortage of lime and where, therefore, there is reason to believe that sulphate of ammonia would not be wholly suitable. It is also entirely suitable for general farm crops and is perhaps the quickest-acting top-dressing known, being even more soluble than sodium nitrate, and at the same time, as part of its nitrogen is in the form of ammonia, it is not so liable to loss if wet weather sets in after it has been applied to the soil.

Like some other very soluble substances, ammonium nitrate is liable to attract moisture from the air, and some samples become unmanageable because they form a tough cake which cannot easily be broken and may become pasty. There are, however, several varieties or modifications of ammonium nitrate, and one of them is free from this objectionable property. It is obtained by recrystallising under special conditions. This non-deliquescent variety keeps quite well in a dry shed: some of it was stored in the manure shed at the Rothamsted farm for ten months without becoming unmanageable. But it is by no means clear that this result could always be obtained, or that sufficient of the non-deliquescent variety could with certainty be manufactured to meet the needs of farmers.

In the case of any fertiliser in England it is necessary to enquire how it would behave in admixture with others, partly because as already stated, farmers prefer to buy mixed or "compound" manures,

and partly because, even when they buy the several substances themselves, they prefer to put them on altogether as far as possible, in order to save labour, a very serious item on British farms where wages are much higher than in many parts of the Continent. In the case of nitrate of ammonia this question would not usually arise, as the proper use of this substance is as a top-dressing.

It was found, however, that should the necessity arise, nitrate of ammonia would quite well mix with superphosphate so long as this material was dry and in good condition, but that if damp, noxious brown fumes were given off, as might be anticipated.

As a top-dressing it had the defect in some instances of scorching the leaves of the young plants, particularly in the drier and warmer parts of the country. At Rothamsted a crop of mangolds was injured in this way in 1914, the small crystals falling on the leaves yielded so strong a solution that the plant suffered considerably. In later experiments the material was applied in a fine interval during showery weather, with the result that it was speedily washed off the leaves and caused no damage at any time. In experiments in the North, where the conditions are moister and cooler, no bad effects were observed.

The results of the experiments showed that nitrate of ammonia behaved very like nitrate of soda for farm crops: for example, for mangolds it was more effective than sulphate of ammonia when reckoned on an equal nitrogen basis, probably, because part of its nitrogen is already in the form of nitrate; for wheat it is equally effective. For potatoes, however, it is more risky than sulphate of ammonia. it gave as large a crop, but induced the formation of a large growth of haulm, which would be a disadvantage wherever there was much blight. The results at Rothamsted have been

	Mangolds tons per acre	Potatoes tons per acre	Wheat			
			Grain bushels per acre		Total produce including straw lb. per acre	
			Expt. 1	Expt. 2	Expt. 1	Expt. 2
Basal dressing.						
+ Nitrate of Ammonia (1) .	23.3	8.8	44.7	37.7	8120	7830
+ Sulphate of Ammonia (1) .	18.6	8.7	41.3	40.1	8180	7775
+ No nitrogen	17.3	8.0	38.6	34.6	7310	7025

(1) Equal quantities of nitrogen are applied on these plots.

As compared with nitrate of soda it has sometimes proved more effective. Thus in an extensive series of twelve experiments on hay land, carried out by HENDRICK at Aberdeen, during the years 1911-1914 the results were as follows:—

			Cwt. of hay per acre.
Basal dressing	Nitrate Ammonia (1)	. . .	56.2
»	» Nitrate Soda (1)	53.8
»	» No nitrogen	50.2

(1) Equal quantities of nitrogen are applied on these plots.

Similar results have been obtained with oats and also with mangolds. It is quite possible that nitrate of ammonia is really the most effective and most valuable nitrogenous manure we have. But as against this enormous advantage there is the serious risk of deliquescence, and until this is greatly reduced it is unlikely that nitrate of ammonia will find an important place in the market.

Urea.

Urea is the most concentrated of all nitrogen compounds offered to the farmer. It has not been the subject of many field experiments in England, but whenever tested as a fertiliser it has proved to be of the same order of value as sulphate of ammonia and nitrate of soda. The difference between these two fertilisers is in any case not very great. If the nitrogen in nitrate of soda is valued at 100 that of sulphate of ammonia is usually worth 96 to the farmer.

But in English farming it is always necessary to take account of possible harmful effects on the soil. Urea is singularly free from these; it does not make heavy soil sticky as nitrate of soda does, nor does it remove lime from the soil as does sulphate of ammonia. The writer knows of no soils on which urea would be unsuitable. It mixes with practically every fertiliser and would cause a minimum of trouble to the manufacturer of mixed fertilisers and proprietary manures. Further, it does not wash out from the soil, but is retained probably as well as sulphate of ammonia, in which respect it is superior to nitrate of soda which in very wet districts, is liable to wash out.

So far as present evidence goes, and it seems quite sound, urea is more effective when drilled with the seed than when used as top-dressing. The experimental results at Rothamsted have been:—

	Barley				Potatoes (1) 1921 tons per acre
	1921		1922		
	Grain bushels per acre	Straw cwts per acre	Grain bushels per acre	Straw cwts per acre	
Basal dressing					
+ Urea	34.0	23.4	33.4	21.8	2.63
+ Sulphate of Ammonia . . .	35.0	23.5	32.3	20.3	2.31
+ No nitrogen	26.1	17.6	25.2	16.8	2.00

(1) This crop almost failed because of the drought

The high percentage of nitrogen in urea gives it a great advantage wherever transport is an important consideration. For the export trade, or for farms situated a long distance from rail or canal, or wherever a long railway journey has to be made, there is a considerable advantage in handling a manure containing 37 % of nitrogen as is the case with urea, rather than in handling one containing only about half this amount. Further, the freedom of urea from injurious secondary effects on the soil, to which reference has already been made, gives it special advantages wherever any such effects cause inconvenience to the farmer. If urea can be put on the English market at the same price per unit of nitrogen as sulphate of ammonia it will undoubtedly prove a serious competitor. Even if it remained somewhat dearer there still remain distinct possibilities for it in cases where the lime-removing effect of sulphate of ammonia could not satisfactorily be remedied, and where nitrate of soda was unsuitable, so long as the disparity of price was not too great.

Ammonium Chloride.

For technical reasons ammonium chloride is one of the cheapest forms in which synthetic nitrogen can be put on the market.

On general grounds it would be supposed that the chloride and sulphate of ammonia must be of equal value as fertilisers. There is, however, much physiological evidence to the effect that the chloride under certain conditions may be harmful to plant growth. It by no means follows that this would happen in practice; whether it would or not can be ascertained only by trial. In view of the technical importance of the salt an extended investigation is being made at Rothamsted and at various centres in England under Rothamsted supervision.

The investigation proceeds on two lines. Pot experiments are made to see whether the chlorine is exercising a harmful effect on the soil, or whether some of the soil constituents are mitigating, or even suppressing, the action.

Field experiments are made to discover to what extent field factors, — such as subsoil, varying water supply, or indirect effects of ammonium chloride on the soil itself — influence the action of the fertiliser.

The pot experiments show conclusively that the chlorine ion has no visible toxic effect on the plant in soil *when all conditions are favourable to growth*. The chlorine and the sulphate had at least equal value when compared on the basis of equal nitrogen content; indeed in the light soil the chloride usually proved the better.

Field experiments gave varying results. In many cases the chlorine proved inferior to the sulphate, especially under rather dry conditions: in other cases there was no recognisable difference between the salts; while in a few cases the chloride appeared to give better results, than the sulphate. It may of course be the case that this apparent beneficial action is simply the usual 'scattering' of field trial results; this will become clear when more data have accumulated. But when the results are set out in detail there is a distinct suggestion that, in certain conditions, the chloride does in fact give better results than the sulphate. What these are can as yet only be conjectured and it is more profitable to await the results of further experiments.

There is, however, one objection to ammonium chloride which in some conditions might prove serious as it appears to increase the risk of loss by drainage. This action is more harmful than that of ammonium sulphate which leads to loss of lime and consequent acidity, because in the case of the sulphate, the calcium compound is certainly not harmful to the growing plant, while calcium chloride is injurious. The harmful effect could no doubt be reduced to a minimum by proper attention to time and method of application, and indeed it is a possible cause of the occasional beneficial results that have been noted above.

The field results have varied with the season. The season 1921 was hot and very dry.

In this year the nitrogen in ammonium chloride had approximately the value of 90, when that in ammonium sulphate was put at 100.

The season 1922 was cold and wet. The nitrogen in ammonium chloride, when that of the ammonium sulphate was put at 100, had the following values :—

For potatoes in 56 tests	99
For mangolds in 18 tests	98
For cereals in 2 tests : Grain	99
Straw	105

The result is so near to 100 that it might at first be supposed that the ammonium chloride was fully equal to ammonium sulphate as fertiliser. Closer examination of the figures shows, however, that one or two results step out very much from the average and raise the value above its true level. When a distribution curve is drawn it is clear that the peak comes somewhere about 96-99, and for the present it is better to take this figure rather than the crude average as expressing the value of nitrogen in ammonium chloride when that in ammonium sulphate is put at 100.

Some of the individual results are as low as 83-88 these are invariably obtained with potatoes grown without dung and with kainit or potassium chloride. It is not usual to grow potatoes without dung, but if for any reason this were being done, it would apparently be inadvisable to use ammonium and potassium chlorides together as fertiliser.

It is at present difficult to say what future lies before ammonium chloride as fertiliser. Almost everything will turn on the price at which it can be sold : it is undoubtedly of great value to the farmer, and when its various effects on the soil and the plant have become better known it will be possible to set out the conditions under which it can be used to the maximum advantage.

Cyanamide.

It is perhaps hardly necessary to refer to cyanamide here since its direct action as fertiliser is not as good as that of the other substances to which reference has been made, and it can be converted by the manufacturer without great difficulty into one or other of them. There can be little doubt that this is the wisest procedure.

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ELECTRO-SILAGE IN GERMANY

I.

- 1) Principles and aims of modern methods of preserving forage.
- 2) Tests of bacteriological and chemical processes in electrically preserved forage and the characteristics of electro-silage.
- 3) The action of the electric current and the possibilities of its economical use.

The depreciation of the currency in the Central European countries since the war has made impossible the importation of good quality forage in any quantity from districts where there is a surplus, and consequently these countries have found it increasingly necessary to make all possible use of their home grown forage by improved methods of ensilage. This is especially the case in those Alpine regions where precipitation is very high and rainfall distribution very unequal. The wet seasons of 1918 and 1922 resulted in several failures of the forage crops, and the shortage of hay, and in particular its dependence on weather conditions has brought into stronger relief the serious shortage of food stuffs and the unfavourable working conditions, due to the difficulties of the economic position.

Taking as a basis the experience already gained over a considerable period with the farm pit-silo, the American turret-silo and the stack-silo, the invention of the Herba-reform-silo in Switzerland in 1917 by Mossner and Sonderegger (followed by several technical improvements in Germany) led to a rapid diffusion of the use of the silo, especially on medium-sized and large farms. The rapid progress made in the preservation of forage is marked by the following systems: Herba-Reformsilo, Switzerland: sweet silage experiments carried out by Gardner and Aurich, Dresden: Duplex turret-silo of the South German Fermented Silage Company (Garfuttergenossenschaft) Munich: and the Ifla turret-silo of the « Industrie für Landwirtschaft », a limited company, Munich.

The essential feature of the latter system is that the spontaneous generation of heat in the loosely packed forage can be checked at a temperature of about 50°C. by means of pressing apparatus.

Lactic acid fermentation in the forage is thereby encouraged, and the forage is thus impregnated with this product of metabasis. In this condition the silage keeps well, and will moreover fetch a good price, provided it is possible to prevent setting up any injurious processes, while its value as a feed is comparable to that of green forage. By this means green forage is practically available in winter, and hence milk production is increased. At the same time at a temperature of about 45° to 55° C. the lactic acid fermentation prevents injurious forms of decomposition such as the giving off of volatile, fatty acids (lactic and butyric acids), and the putrefaction of the albumen is avoided.

A comprehensive literature is now in existence, describing all the above methods with their advantages and disadvantages (see bibliography). They differ for the most part in technical details, permanent improvements having been introduced during the last few years in the pressing apparatus. Thus for small farms the *Herbasilo* with its horizontally fitted screw press (double chain) is indicated as the most suitable, while the *Illa-turret-silo* with its easily regulated piston apparatus appears to be the best for large farms.

Leaving out of account those advantages of ensilage which though of importance may now be regarded as indisputable (e. g. more assured profits, partial economy of plant substance, better distribution and economy of labour, increased production, the rapid clearing of fields making a succession of crops possible, economy of space, avoidance of risks of fire and insurance charges) silage methods may be compared from the economic standpoint by reference to the following main criteria of the general problem

1. Economy of the sources of energy (sources of warmth, fuel)
2. Maintenance of the forage under conditions giving the highest possible nutrient value.
3. Production costs.

If these points are taken as the standard by which the existing methods of preserving forage are to be judged, it is obvious that if the price of conservation of energy is the expenditure of valuable plant substance, this is an uneconomical process. It is only in the modern compression processes that the losses are relatively insignificant. Generally speaking the loss of nutritive substances in hay amounts to 20 to 50 %, in sour forage 30 to 50 %, in forage compressed by the older methods 20 to 30 %, in modern silage 5 to 30 % and when the method of inoculation with pure lactic acid bacterial cultures is em-

ployed, 5 to 10 %. The percentages can even be reduced to 1 to 2 % in the electric ensilage processes still to be described.

There is moreover usually an element of uncertainty introduced, due more or less to weather conditions, the manipulation of unaccustomed and somewhat complicated processes, and finally to chance itself. Hence it is not surprising that the small farmer has kept to the old-fashioned use of dry hay and the newer compression methods have in the main been adopted on the larger farms only.

The whole question of ensilage has been placed on an entirely new basis, the full bearing of which it is not yet possible to estimate, by the discovery made a few years ago that by means of electric current a silage can be obtained which is not only in no way inferior to the silage produced by other methods, but possesses the important advantage, of allowing green forage to be harvested in wet weather without loss

The manipulation of the electric silo is at the same time very simple and does not involve heavy working expenses. The practical experience gained in the last two years with the electric silo all goes to prove that if the instructions for working are carefully followed an excellent silage can be obtained from the greater number of the forage plants. Moreover, independence of weather conditions, one of the most important desiderata of the whole problem of ensilage, is also secured. Further experiments suggest that a wider and more important principle of the economic preservation of forage, the avoidance of expenditure of the plant substance itself as a source of energy will shortly be realized.

The credit of having discovered the electric method of ensilage and of having made it of practical use to agriculture, belongs to the agricultural scientist, Th. Schweizer, a Swiss by birth. The world-renowned firm of Siemens-Schuckert, Berlin, undertook the manufacture and formed a special "Elektrofuttermittelgesellschaft" (Electric Silage Co) in Dresden, Reichstrasse, 1. This company also undertakes the sale of the electric silo.

The countervailing drawbacks to the important advantages of the electrosilo are not very serious. Apart from the fact that it can be used only where electric current is available, the return on outlay taking into account the cost of the current is only ensured, if correspondingly large quantities of forage are treated and at the same time technical defects avoided. In the case of smaller farms it seems particularly advisable to make a careful estimate of costs and

returns, taking into consideration the capital outlay, the cost of the current and of working, the nature and quantity of the forage to be ensilaged, the existing demand, etc. In this connection it should be noted that when fodder is scarce, especially in wet seasons the saving of a single aftermath crop may cover the cost of the whole silo installation. Mention may here be made of the effect of electrically treated ensilage on the cheese-making properties of milk. According to the experimental tests of the research stations in Bern-Liebefeld (Switzerland) (1) and at Wangen (Allgau) milk yielded by cows fed on electric silage proved to be of no use for the manufacture of high priced soft cheeses (2). But by adding sour cream cultures to this milk all drawbacks as regards taste are avoided. All the so-called defects are thus of very little importance in comparison with the numerous advantages of the electric silo.

To sum up, it may be said that the present position as regards existing practical methods of ensilage is that the electrical conservation of green forage plants is of all the processes the one that has reached the highest technical perfection. It is possible by this process in almost any weather to make good silage of uniform quality with only a negligible loss in dry weight and no essential exhaustion of the valuable protein substances. Whether viewed quite generally or from the standpoint of the national economy the greatest importance attaches to the increase in the milk yield attained by the use of this silage. It is reckoned that the increase is 2 litres per cow per day. Hence all the more is it incumbent on science and technology to remove existing defects so as to ensure economy and a conservation that is in the fullest sense reliable. In particular every effort should be made to devise a process which reduces the electricity used both in point of time and of strength so as to save charges for current, and thus be within the means of the smallest farm. The current might well be used exclusively at night-time when it is cheaper, and a movable plant arranged by which several silos could be treated successively, and the desired reduction in expenses thus secured.

There seems every probability that the method will be generally adopted. Feeding with roughage would thus become the more general practice in winter, thus saving the expense of dearer feeds

(1) There is every reason to suppose that in Bern-Liebefeld the material used in the experiment was not the electrically prepared silage, but a sour silage containing butyric acid. The same is generally true as regards the chemical experiments made at the Higher Technical School at Zurich.

(2) See No. 784 of this *Review*. (Ed.)

and also the farmer with a small holding would have a silage plant for his home grown forage, of a simpler, more easily manipulated and economical type than those now in use.

Thus the scientific farmer would be in a position to procure winter silage for his stock, exactly as in every well regulated household it is taken for granted that provision will be made for the more costly winter needs by preserving fruit, making jam, etc. It should also be remembered that an outbreak of foot and mouth disease may often be checked by supplementary feeding with silage prepared electrically. Most probably other symptoms of oncoming disease, such as the licking habit in marshy districts could be controlled by this feed (1). These questions should form the subject of special investigations.

II.

In contrast with the satisfactory practical experience with the electrosilo, and the definite need for cheapening and improving it, there is only a very slight knowledge of the influence of the electric current on the actual condition of the forage. This is due to the fact that in the treatment of the forage by industrial electric currents a new discovery is being made, the full explanation of which is still far from being clear to science. From the technical standpoint the electrosilo had its predecessor in a preserving apparatus used for fruit, jam making, etc. which was invented some years ago. The physiological aspect of the processes induced in plant substances by electric energy is completely unknown, although the important modern investigations in the chemistry of physical processes make it certain that electricity has a direct influence not only on the molecular but also on the atomic energy of plants and that fixed laws govern this influence (quantum theory, theory of electrons). No deeper insight into the physical processes as they appear in electric ensilage will be possible within any inmeasurable span of time, seeing that we possess no sense organ for electricity nor any means or apparatus, by which we can accurately perceive and register its action.

The problem as to the action of the current is therefore pre-eminently one for the research worker.

It can thus be readily understood that exact scientific results in regard to the conservation of forage by means of the electric cur-

(1) See No 677 of this *Review*. (Ed.)

rent are only very meagre. On the technical side pioneer work has been done in recent years by the highly developed German industries. As to our knowledge of the chemical principles underlying the silage problem no essential advance has been made, and the only names connected with modern research into the problem of electric conservation are those of VOLTZ, FINGERLING and M. SCHULZE (1). No work has as yet been done in connection with the interesting and important biological questions of the electrical sterilization as occurring in silage. Only quite recently Prof. SCHEUNERT and Dr. SCHIEBLICH in Berlin have begun to investigate electric silage and almost at the same time Councillor Prof. KINSEL and the present writer started experiments at the Bavarian *Landesanstalt für Pflanzenbau und Pflanzenschutz* (Agricultural Institute for Plant Culture and Protection), Munich. The following is a brief account of the results of the experimental work at the Bavarian *Landesanstalt*.

The first care of the experimenters in their search for practical results was to make a close examination and study of every phenomenon that appeared to be the immediate result of the electric treatment. Up to the present there have been no bases for a comprehension of the action of the electrosilo, and the existence of the most diverse theories is therefore easily explicable.

It is maintained by silo experts that the bacteria cannot be killed by the current, while the inventors of the electric silo express the contrary opinion in their articles explanatory of the system.

The influence of the current on the micro-organisms in the electrosilage is undoubtedly a matter of first importance and closely allied with this is the question of the behaviour of plant substance as a carrier of bacteria.

Numerous experiments have shown that the number and kind of the bacteria present in the silo largely determine the processes of conservation and are in reality the cause of injurious metabolism in the plant substance. On the other hand the favourable action of lactic acid fermentation set up by the lactic acid bacteria at that stage is highly desirable, provided that the development of the amount of lactic acid necessary to conservation is not accompanied by detrimental changes in the plant substances.

The electric turret silo on the Steinbeise estate in Brannenburg,

(1) Work has also been done recently by G. WIEGNER, C. CRASEMANN and M. KICIBER in Zurich, and is reported in the *Landw. Jahrbuch der Schweiz* 1923, Part 4.

Upper Bavaria, was used for bacteriological experiments in connection with silage. It was erected by the Electric Silage Co. of Dresden and worked in accordance with their instructions. The electric poles in accordance with the Schweitzer plates system consist of an iron grating on the floor of the silo and a sheet tin cover in six divisions which is laid on the forage mass after the silo has been filled. By means of a transformer the tension of the current available for the process was raised to 380-220 Volts. As only one receiver was to be used only one phase of the alternating current could be applied. The walls of the receiver (silo) consist of grooved concrete made on a special pattern. This concrete is faced on the inner side with insulating material, which forces the current to pass through the forage mass. Meadow hay was always used for the experiments, wet with dew, chopped to one and a half centimetres and placed in the receiver in layers. The grass was the yield partly of a water meadow with poor herbage including many kinds of rushes, partly from an average meadow with good herbage. Both were typical mountain pastures of the Bavarian Alpine foot-hills. In order to ascertain what micro-organisms were present, bacteriological tests were made on October 25, 1922 by the HILTNER method of pure cultures in a pulse nutrient medium which on calculation showed the following results

Total number of bacteria in one gramme of grass.

1 fresh grass from	Cultures			Average
	A	B	C	
Poor meadow	150 400 000	126 000 000	460 800 000	153 200 000
Good meadow	238 100 000	294 400 000	431 800 000	322 800 000
			Average	386 000 000

The number of bacteria present in the grass is according to these experiments normal and the same is true as regards the type of micro-organisms found. No steps were taken for isolation of pure cultures after it was ascertained that the micro-organisms present belonged mainly to the lactic acid forming type (long and short lactic acid bacteria and micrococci of the lactic acid forming type), with a large intermixture of *Bacillus subtilis* and a few fluorescents. The practical purpose of the work made it unnecessary to distinguish the numerous varieties with their uncertain classificature. The chemical

analysis was carried out at the "Hauptversuchsanstalt für Landwirtschaft" (Agricultural Head Experimental Station) in Munich with the following results

	Poor meadows	Good meadows	Average
Water	83.24 %	84.24 %	83.74 %
Dry substance	16.76	15.76	16.26
Protein	2.71	3.10	2.91
Crude fibre	5.02	3.10	4.06
Acidity	0.28	0.34	0.31
Volatile acids (butyric and acetic acids)	—	—	—

At the time the silo is filled a shaft is built into it, made of overlapping boards, with holes in the side, so as to make it possible to remove samples of the forage from different places in the silo. The electrification of the green forage mass of 493.2 centners (20 double yoke loads with 27.4 cubic metres capacity) was effected by a normal application of current (1).

The silage when finished was olive green to brownish in colour had the aroma of freshly baked bread and was readily eaten by stock. Samples of the good and the poor grass were taken after electrification on 15 November and were subjected to chemical analysis.

Micro-organisms per gramme of electro silage

Electrosilage taken at	Cultures			Average
	A	B	C	
25° C. 55 cm above floor of silo (poor grass)	100 000	nil	nil	133 000
43° C. 178 cm above floor of silo (good grass)	nil	100 000	nil	133 000
		Average		(2) 133 000

(2) *Penicillium* only

(1) The cost of current may be ascertained in accordance with the price of electricity by applying the formula that 50 kg of green forage require one kilowatt per hour. The cost of constructing a silo is determined by the number of cubic metres of the space enclosed. The largest silo cost from 10.5 gold marks per cub. m. and the smaller 17.5 gold marks.

The analysis of acids showed a content of 0.77 % of lactic acid at a temperature of 26° C., and of 1.31 % at 43° C.

The bacteriological result was unexpected in more than one respect. The sample was practically sterile not only at 43° C. but also at 26° C. the temperatures at which the samples were taken. It is not to be supposed that the process of ensilage is only achieved at these temperatures. Very often a temperature of 45-50° C. is reached and is a main factor in the production of lactic acid fermentation.

Temperatures of 45 to 50° C. can be obtained by other silage methods, but these temperatures are not sufficient to destroy the injurious, sporogenous and highly resistant hay bacilli. In the electrosilo however the hay bacillus, which can resist all the effects of natural selection and crowding out by other organisms disappears entirely. There was also a very striking absence of all micro-organisms when the hay was taken out of the silo at a temperature of 26° C., whereas it might have been expected that the injurious hay bacillus which thrives in low temperatures would once again be found. It is well known that the production of lactic acid by the lactic acid bacteria involves an after fermentation. On the other hand it was to be expected that the electric current would at least have a selective destructive action on certain groups of bacteria. This was confirmed by the fact that even in the streaks there was no sign of renewed activity. In every case it is to be noted that in the Brannenburg experiments a temperature of 45 to 50° C. has been reached in the silage process.

The interesting question now arose whether the electric silage would remain sterile. The silo was left untouched all the winter, until on 26 January 1923 it was necessary to open it because of the requirements of the farm and samples were then taken and analysed as the final stage in the experiment. There was no change in the appearance of the forage; it was as at first olive green to brownish, had a pleasant odour resembling bread and was readily accepted by the stock. The milk yield maintained the average customary for the dairy cattle in Brannenburg fed on the mountain grass as described. The silage was packed into the container so that the samples could only be taken by means of a specially constructed spoon shaped implement. Examination for micro-organisms gave the following total number of bacteria to one gramme of electro-silage :

Electro silage taken out at	Cultures			Average
	A	B	C	
4° C. (at a dept of 30 cm. in the silo)	nil	nil	nil	nil
2° to 6° C (at a depth of 1.2 m in the silo) . .	400 000	—	800 000	100 000
			Average . .	200 000 (1)

(1) *Penicillium* only

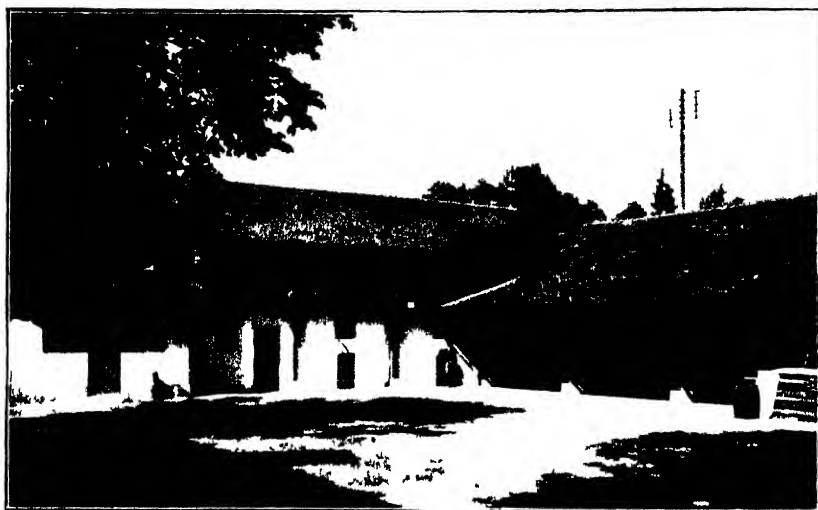
According to the chemical analysis the feed has the following composition :

Water	77.0 %
Dry matter	23.0 %
Protein	3.31 %
Crude fibre	4.96 %
Total free acids	0.49 %
Volatile free acids	0.20 %
(Acetic acid admissable	0.5 %)

Taking the experiment as a whole the following description may be given of what took place during the forage conservation.

The chopped wet grass had been practically rendered sterile and so remained for the whole time it was kept in the turret silo (90 days) By the action of the electric current not only were the lactic acid bacteria destroyed, but also bacteria resistant to high temperatures of 70 to 100° C.

The removal of valuable constituents, such as albumen, which usually results from the losses in substance, did not occur to any marked extent through the process of electric ensilage. This fact suggests that the injurious processes of decomposition are largely checked by the electric current and in any case are unimportant. Hence the products of decomposition, such as free organic acids, appeared in very small quantities only, remaining considerably below, the limit of error. No butyric acid could be detected, and only traces of acetic acid, while lactic acid only occurred to the extent normally found in autumn forage. Hardly any of this acid has been lost, and there is more than enough to prevent any renewal of activity in the bacteria and therefore to preserve the silage.



View of the Central block of model installation with six electro silos belonging to the Electro Silage Co. Dresden C. (August Meißel-Bild-Tolz)



FIG. 11. View of six silos with suction tube plant for blowing in the chopped forage

As regards the chemical changes which take place in the silage, the loss of water is chiefly due to the evaporation caused by the heating of the grass mass. Accordingly the dry matter content of the silage is very high compared with that of the mass of green grass, and the same is true of the crude protein and crude fibre content. The albumen content in the dry substance was actually only reduced by 1 to 2 % except for a few tenths per cent., which come within the limit of error. Since the lactic acid bacteria hardly attack albumen at all (1), the material for forming the lactic acid is chiefly to be sought in the N-free portions. According to SCHULZE's experiments the electrolytic process which takes place in the electro-silage brings about the splitting up of the otherwise refractory crude fibre into N-free extracts, a fact of great importance from the nutritive physiological standpoint, and thereby increases the availability of the silage. It is worthy of mention, as evidence that practically no substantial change had taken place in the forage as a result of the ensilaging process, that a cow in Brannenburg which was accustomed to good grass recognised even in the form of silage that poor grass had been placed at the bottom of the silo, and refused to eat it.

Losses arise not only as a result of bacterial activity, but also of the respiration in the layers of forage plants which are still alive, the loss being chiefly from the carbohydrates. Previous experiment has shown that the action of the electric current sets up rigidity of the cell plasm (2) which probably at once inhibits respiration. If the cell is not already dead, it is certainly destroyed when the temperature rises to 35° C., a temperature reached in the electrosilo soon after the current is applied. As has, however, been said the losses are quite negligible.

The electro-silo thus fulfils two of the main requisites of a method for the preparation of conserved forage: 1). The source of energy is well suited to the purposes so that all waste of nutritive substances is avoided; 2) The nutrient value of the forage is retained as the method allows conservation at the right stage even under unfavourable weather conditions, as has been fully shown by the numerous experiments described.

(1) This experiment proves beyond doubt that the conservation of forage by electricity is a method of special excellence, since it makes possible the sterilization even of wet grass, and its preservation in practically perfect condition.

Naturally the lactic acid bacteria need a small amount of nitrogen for their own life processes.

(2) BERSA and WEBER, Reversible Viskositätserhöhung des Cytoplasmas unter der Einwirkung des elektr. Stromes. Reports of the German Botanical Society, Part 7, 1922.

The importance for agricultural production of these merits in the electrosilo is clear from the following facts :

For some years past the agricultural division of the *Landesanstalt* has been carrying out in different parts of Bavaria under the direction of Regierungsrat (Councillor) LANG experiments in the application of nitrogenous fertilisers to meadows, one of the places chosen being the Steinbeis estate at Brannenburg in Upper Bavaria. The object of these experiments was to determine the effect of nitrogen upon the yield and quality of the meadow grass, and the agricultural profits to be obtained from the use of nitrogenous fertilisers. Though not yet complete, they have been carried far enough to prove that nitrogenous fertilisers under certain conditions pay extremely well. At Brannenburg in the dry season of 1921 there was a yield of only 450 double centners per hectare of green forage, corresponding to 90 double centners of hay, as the result of four mowings. One kg. of pure nitrogen applied as manure produced up to 50 % increased yield of nitrogen in the form of protein, so that the balance as regards nitrogen is entirely satisfactory. Hay harvesting owing to the uncertain and rainy weather that prevails at Brannenburg is always difficult : the Herbasilo is of no use, as it requires a succession of good haymaking days. The electrosilo is the only type suitable for stacking and preserving the crop without loss.

A report has been issued by the Steinbeis estate of the Bavarian *Landesanstalt* on the experience gained by the use of the experimental electrosilo at Brannenburg, of which the essential points are as follows :

" The electro silo was erected in the summer of 1922 at a cost of 200 000 paper marks, the necessary technical assistance being provided by the Electric Silage Co. It is a turret silo with a total forage capacity of 70 cub.m. (One cubic metre corresponds to 18 to 20 centners of green stuff : this amounts to about 25 to 30 days rations, if silage is fed exclusively. After mowing the forage is put into the silo chopped to lengths of one and a half cm. The hay is allowed to lie on the meadow for one to two days, and rather longer in wet weather. The passage of the current is facilitated if the grass is not too dry and withered. If the forage is put into the silo fresh, no nutrient material is lost. The silo does best when filled to the height of one metre, and this mass will be silaged in 6 to 10 hours. It is then chopped again and every evening the six-piece cover (the electrode) is replaced, and the current again passed through, till the con-

servation is complete. It is an advantage if two tensions are available. The stronger current is first applied, then the weaker, till an equable temperature of about 50° C. can be established. The alternating current is the most suitable whereas in other silage methods heat is produced by the respiration of the plant cells and the bacteria, in the electro-silo the current is the heat generator and it therefore becomes possible to introduce the forage at any stage.

It is desirable that there should be some air in the silo, as it assists the passage of the current. The forage must be placed in layers as thickly and evenly as possible. By the passage of the current it will soon be seen if the forage has been sufficiently compressed. Forage which has lain for two hours under the influence of the current and is then thrown out and remains lying in heaps, is no longer capable of spontaneous heating.

When the process was complete the silage had still kept its original appearance and smell as on the first days after the ensilaging. This applies even to the lowest layers, this part of the silage *remaining unaltered even after six months*. There was no visible oozing of juices and no moist sediment on the floor of the silo.

After the inferior grass was removed the silage was readily eaten by the stock. The agricultural profits to be obtained from an electric silage plant, are assured except just at the time of installation. Although no exact accounting data are available, there is every reason to believe that, given the benefits that have already been obtained from the use of the silo under the conditions here prevailing, the initial outlay will be very soon written off. Among the principal advantages may be mentioned the following:—

1) The grass can be cut and carried to the silo at any time and can be kept there in its original condition and without loss.

2) Harvesting of the forage crop can begin earlier, and hence the growth period can be used to better advantage. The heavier rainfall of June thus benefits the second crop, instead of coming in the middle of the haymaking.

The meadows can be much more heavily manured. The use of nitrogenous fertilisers after the first and second cutting will pay well and a twofold increase in the hay yield may be reckoned.

4) The earlier and more frequent cutting (as many as four cuts being possible) and the more intensive manuring enrich the meadows. The weeds that are annuals disappear.

5) More head of cattle can be kept on the same or a smaller

area, as both in summer and winter there is always fresh rich forage for the animals. The milk yield is subject to less fluctuation. There is no need for additional purchases of concentrated feeds.

The electric current method of forage conservation thus appears from every point of view to be highly important to the national economy. Up to the present however an approximate estimate only of the results is possible.

III.

Judging by the foregoing experiments (1) it is impossible to doubt that the electric current has the power of killing bacteria and life in the higher plants, and also of conserving the green forage to a remarkable degree. But in spite of this the specific action of the electric current remains as yet unknown. This problem seems to call for elucidation, although the practical outcome of the process, viz : the electric silage itself, hardly admits of further improvement. But only the specific action of the current can give the clue to the form the application of the electricity should take scientifically, so as to keep the expenditure of current and the costs of production as low as possible. This is the difficulty not merely of "electrosilage" but of the whole question of ensilage, bearing in mind that the electro-silo meets all the other requirements of a satisfactory method of forage conservation. In so far as the bactericidal action of the current was considered at all, it was ascribed mainly to the fact that since forage is a bad conductor of heat, warmth is generated, which kills the bacteria at about 50° C. In order to make the action of electricity more intelligible, the forage mass has been compared to the metallic wires in the interior of an electric bulb, or to an, "incandescent" carbon burner in which heat is generated through electricity as a consequence of resistance to the current. Without denying that many species of bacteria are destroyed by heat, the bacteriological experiments of Prof. KINZEL and of the present writer give reason to suppose that there are other specific effects of electricity. It is *a priori* clear that a living organism reacts to electricity quite differently from a piece

(1) The results of experiments are confirmed by the electro-silage experiments carried on simultaneously by Prof. SCHÜNERT and Dr. SCHIEBLICH Berlin. While meadow grass was used in the Munich experiments, turnip leaves, serradella and carrot tops were used in Berlin.



FIG. 35. Interior of the
fossil (temperature after removing the electrode)

of metal or a carbon thread. The reasons for the action of the current will differ according to the kind of forage in the silo, the structure of the plants, the pressure, the shutting off of the current, the relative position of the electrodes, the amount of humidity present in plant juices, the sourness, and also according to the type of current, whether alternating or uniform. The following possibilities must also be taken into account: production of electric heat in consequence of the resistance to electricity of forage plants which are bad conductors, protected as they are by the waxy layers of the epidermis, electrolysis of the fluid components due to the formation of bactericidal poison (formation of Chlorozone), mechanical effects caused by the loosening and destruction of the tissues, physiological effects due to temporary or permanent hardening of the cell plasm, the various micro-organisms showing themselves either sensitive or protected by layers of cuticle or mucous membrane, specific action of high-tension alternating current, discharge of sparks, production of ultra-violet rays, diathermia (?), automatic induction and so on.

In accordance with the fundamental assumptions of modern electrophysiology, electricity passing through a living organism (see fig.) reveals its presence *not merely by the generation of heat*, but also by the fact that it sets up vital phenomena, or inhibits them or changes their form or direction. This important fact has been used and adopted in electrotherapy, while in the sphere of agriculture it has not yet been turned to account for want of a corresponding technique. One of the manifestations of the types of electrical activity just mentioned is known as a "stimulus" in the widest sense, in so far as it produces excitement, inhibition, or paralysis which may lead to permanent functional and anatomical injury. Accordingly the question under consideration is that of electrical stimuli during the action of the current on the stalks of the forage plants. These fall under OHM's law and in this connection inhibiting action is particularly noticeable.

Ohm's law deals with the relations between electromotive force (tension), resistance to conductivity and strength of current (intensity). The interplay of these factors determines the specific effective potency of the current and this finds expression chiefly in thermic, chemical and mechanical action. The strength of the current is the chief factor determining the cost of its use. Since the forage mass in the electric silo constitutes a conductor of the second class thus involving a high resistance to conductivity, it is essential, if phy-

siological inhibitions are to be obtained, to secure a high electro-motive power (tension). In the case of bacteria this tension will be still more important, as it is necessary to penetrate the natural protective media, such as cutine and waxy layers, mucous linings, etc.

In view of these considerations an experimental proof of these theories will be of special interest and the question arises exactly how the electric current at high tension, without any rise in temperature, can affect the bacteria and this at the most important stage in the process of ensilage. In the following experiments of Prof. KINSEL and the writer, the strength of the current was kept very low in order to avoid a rise in temperature.

Ten grammes of fresh grass were put into a flask containing a litre of water and for a period of 12 hours a current was passed through twice every hour, the mixture was electrified, lead electrodes being used and an alternating current at a tension of about 20000 volts and one tenth mille amperes applied. In this combination of factors the experiment corresponds to the first phase of conservation in the electro-silo, when the resistance of the forage mass is very considerable. The experiment is of course only intended to solve general problems as to the effect of the current, and no exact correspondence to the conditions of the electro-silo can be expected. To test the influence of the high tension current on the bacterial content of the grass, the micro-organisms per gramme of the content the flask were counted. There were found to be :

Average of two tests	
Not treated with electricity	Treated with electricity
31 000 000	80 000 000 micro-organisms

The multiplication of the bacteria to far more than twice the original number indicates that even apart from electro-heat the current has an influence on the bacteria which can only be regarded as a stimulus. No change in the temperature had occurred, the electricity had during the short time of its application in no way injured the vital functions of the bacteria but on the other hand had been favourable to them. As a set off to this experiment another might be devised corresponding to some extent to the last phase of the electric ensilage process, when the action of the tension current in the silo has broken down the resistance of the forage mass and the electricity passes without hindrance through the forage and since there is no resistance, no more electro-heat is generated.

CULTURES.



Untreated (numerous micro organisms)

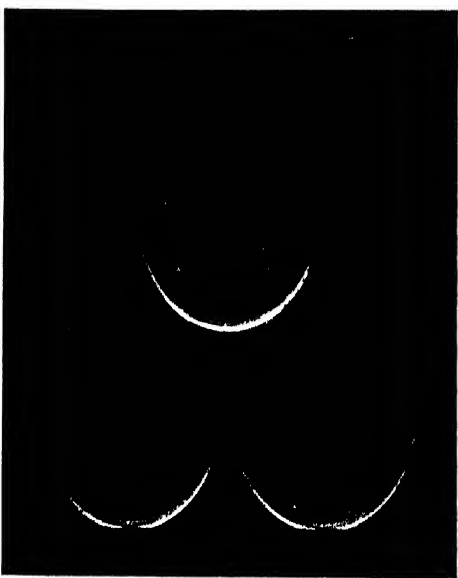


Fig. 9. Treated with electric current: See Experiment S. 8: (very few micro organisms). Effect of high tension alternating current on germinating capacity of the bacteria

Living shape,*

Rigid shape after destruction of life by the electric current.

* Fig. 98. -- *Euglena viridis*, micro-organism of the Flagellatae

A bacteria-containing fluid *free from any infusion of grass* was electrified as in the preceding experiments, and in this case no change took place in the temperature which remained the same before and after treatment by a high tension alternating current of low power (1).

The bacterial content of one gramme of fluid in the cultures was as follows :

		Not treated with electricity			Treated with electricity		
		Anaerobic	Aerobic	Total	Anaerobic	Aerobic	Total
Micro-organisms (in thousands), Dilution 1 : 1,000 :							
Culture tests	A	700	350	1 050	nil	40	40
	B	725	350	1,030	"	63	63
	C	307	610	917	"	36	36
Micro-organisms (in millions) Dilution 1 : 1,000,000 :							
Culture tests	A	620	320	1 000	nil	28	28
	B	400	800	1 200	"	40	40
	C	—	—	—	"	27	27

The bacteria, particularly the anaerobic forms, have been almost completely destroyed as the result of the electric force (tension) of the current. There was no possibility of the action of electro-heat in this case. (See fig. 97).

It is therefore clear that the specific effects of the electricity are also of significance in the electro-silage. It is also probable that complete sterilization was obtained in the tests made with the Brannenburger silo simply because the tension was sufficiently high and hence the hay bacilli, which are usually so difficult to kill, were destroyed.

In any case the experiments described above show that for electric sterilization the high tension of the current, among the factors of Ohm's law has special importance, and that along these lines it may be found possible to reduce the current consumption and the production cost of electro-silage. The experiments also suggest the importance of investigating these processes as they occur in electro-silage in order to avoid unnecessary current consumption and to

(1) The experiment carried out at the *Landessanstalt* confirmed the results of a great number of experiments made by the present writer some years ago

reduce the cost of employing this form of silo. More recent experiments with high frequency apparatus prove that by the application of high tension alternating currents with more than a million alternations per second the coniform coagulation of the albumen follows as the result of the diminution of intensity of the electric force at the pole of the electrode. It is thus also probable that the current density in the forage is of special importance for the complete electro-sterilization.

Scientists have already studied the question of the best use to make of the specific effects of electricity in electro-silage and in particular so as to secure conservation in the shortest possible time. VIETZE of Halle was the first to formulate a method based especially on electro-heat. Spiral electrodes known as "electro-forage boilers" are inserted into the forage mass and directly connected with a high tension wire. In this way the three phases of the alternating current may be applied to a single silo container to economize power.

This method has so far been insufficiently tested to justify a definite opinion as to its value. The new method which is now being perfected by the Electro Silage Co., and is said to embody the results of the latest work on the electric ensilage problem, appears to be still more promising. In this system, rod shaped electrodes are inserted laterally into the mass of forage. This new method may in point of fact indicate far reaching improvements, and merits special attention, as it represents on the one hand a particularly suitable means of conservation for average sized and small farms, and on the other provides that the required temperature will be reached in a considerably shorter time than was practicable by the methods hitherto employed. According to the preliminary experiments made by the Company, favourable results may be expected. In the coming spring detailed tests will be made with the new method by the *Landesanstalt* with the help of the Steinbeis estate.

It is to be hoped that the combined efforts of science and technology may be successful in bringing the electro-silo to such a stage of perfection that it may be able to supply the needs of even quite modest farms as regards a reliable method of forage conservation. It will only be possible to speak of a real solution of the electro-silo problem when in every case a high quality feed can be obtained such as was shown to be possible in the experiments made at the Brannenburg silo. If, owing to technical defects or mistakes in preparation an electro-silo produces a forage which shows marked signs of sour-

ness as the results of the presence of butyric acid, it would be quite misleading to quote this as instance of electro-silage.

Science and technology must also combine to reduce the production cost to the point where it no longer stands in the way of a general adoption of electro-silage methods. The object of the present article is to suggest the means to this end.

It also suggests the high economic importance that can be claimed for silage methods and more particularly for the electro-silo as regards the development of agricultural production. Its possibilities for making good the shortage of cattle feeds are illustrated by a number of examples drawn from agricultural practice showing that by the use of electrically prepared forage the milk yield can be raised by about 50 %. Although modern methods of forage preservation may provide a valuable and nutritious feed it can never of course be a complete substitute for the rich concentrated feeds, and the existing shortage in this respect can only be satisfactorily relieved when these concentrates once again reach Germany in sufficient quantity.

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AGRICULTURAL INTELLIGENCE

AGRONOMY.

SYNTHETIC ARTICLES.

531. The Estimate of Probabilities Applied to Field Experiments.

I. — Bibliography of Standardisation of Field Experiments. *Journal of the American Society of Agronomy*, Vol. 15, No. 1, pp. 33-40. Lyon Block, Albany N. Y., 1923.

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On the occasion of the Meeting of the American Society of Agronomy, in November 1922, the Committee on Standardisation of Field Experiments presented a list of 155 works dealing with the standardisation of field experiments. Among these works (most of which were published between 1910 and 1922), there are a considerable number that deal with the interpretation of results, including the estimation of probable errors, and hence with the estimate of probabilities as applied to agriculture.

The International Institute of Agriculture has not reviewed any works published on this subject since 1918, therefore we here give a summary of ROEMER's article (published in 1920), which is a very clear exposition

of the question. We will afterwards speak of the practical application of the method of calculation as established by VON RÜMKE.

II. — The technique of field experiments made great progress during the years shortly before and after 1880, and then became stationary; it is only recently since VON RUMKE published his methods of research that much attention has again been given to the question.

The method of carrying out field experiments differs according to the objects in view, which vary greatly and may include the testing of fertilisers, the trial of species and of their value for breeding purposes. The more specialised the experiment, the more valuable are likely to be the results.

In order to ensure success, the following conditions are always indispensable; personal interest, the services of a competent Staff, sufficient means at the disposal of the investigator and a homogeneous experiment field.

The accuracy of field experiments. — The value of each experiment depends upon the exactitude of the harvest results, which is best insured by the determination of the average error which should be expressed as a percentage of the suitable value. It has been calculated according

to the law of GAUSZ that $m = \frac{\sigma}{\sqrt{n}}$ where m is the average error of the mean,

σ the average error of each experiment or the deviation from the mean, and n the number of experiments. These values m and σ are also employed in treatises on variation and heredity, and the author is of opinion that it would be better to adopt them in agricultural chemistry rather than r , the probable error which is equal to $0.645 \times \sigma$ and $R = 0.645 \times m$, values, depending upon the "chance curve" of GAUSZ

Application of the estimate of probabilities. — After much discussion on the part of authors such as BAULE, RODEWALD (mathematicians) and ALEXANDROWITCH, LIHRENBURG, GORSKI, HALL, MERCER, PFEIFFER and RUSSELL, it has been agreed only to take into account in field experiments those results that arrange themselves symmetrically according to the curve of GAUSZ. A distinction is to be drawn between systematic errors and chance errors. Under the former head come in the first place all differences in the soils of the experiment fields owing to which, field-experiments can never be as accurate as laboratory experiments. Accidental errors are of many kinds and may consist of variations due to persons, or instruments, disturbances caused by higher animals, insects, diseases, and weather (hail, wind rain), theft of sheaves, etc.

Accidental errors may be larger, or smaller, than systematic errors and may mask them, or be masked by them. Errors due to accident are characterised by their at one time increasing and at another time decreasing the results. GAUSZ's curve can be applied to them. Systematic errors may deviate from the above curve, but even in these cases, it is still possible, according to BAULE, to calculate the average error, but not the value of the probable error which can only be done by means of the symmetrical curve.

The accuracy of field-experiments as at present conducted, is very

low, the value of m being about 10 %. This is not at all sufficient, for any useful work, m must not exceed 3 % at highest.

Investigations into the sources of error in field experiments. — In order to correct the technique of field experiments, it is necessary first to determine the amount of the errors due to different circumstances for it is useless to correct small errors unless the large ones are rectified. By estimating the probability, it is possible to determine the effect exercised upon the accuracy of the experiment by such factors as the size of the crop, the homogeneity of the soil, the size, shape and situation of the plots and the number of repetitions. For this purpose the author has made use of a large amount of material, the crop results obtained from a series of experiments carried out by 9 different authors of which the figures are summarised in 13 tables.

Shape of the plots. — The more homogeneous the soil, the less is the accuracy of the experiment affected by the shape of the plots. Much attention must be paid to a suitable selection of the form of plot when the total area is extensive. Elongated shapes give more exact results than any form approaching a square.

Arrangement of the plots — It makes little difference how the plots are arranged. MITSCHERLICH advises their being in a line, while FINEKE prefers that they should be placed in a square.

Size of plots — This has a great effect upon the accuracy of the results. The larger the space occupied by each individual plant, the greater should be the size of the plot.

According to the calculation of the average error, it may be said that the accuracy of the results increases with the size of the plots, but the decrease in the average error thus obtained is greatest when the soil is least homogeneous.

The ratio between the amount of the average error and the size of the plot can be expressed by the following formula $\frac{V}{\sqrt{g}}$ where v is the average

error expressed as percentage and g is the multiple of the original size. By the help of this formula, it is possible in any case to find how much the plots must be enlarged in order to reduce the average error to a determined figure.

Number of repetitions. — Theoretically it is to be expected that the average error of the mean should decrease with the increase in the number

of repetitions according to the formula $\frac{\sigma}{\sqrt{n}}$ where n is the number of plots,

and this formula can be applied practically. The number of repetitions, or parallels, is the factor exercising most influence upon the accuracy of field experiments and the most effective way to correct the technique employed is to increase the number of parallel plots.

Total surface of the experiment field. — If the number of parallel plots is increased without increasing the total area, the area of each plot is necessarily diminished which does not tend to promote accuracy. A si-

milar lack of accuracy often results from extending the total area as well as increasing the size of the plots, for in this case the soil may be less homogeneous. Parallel plots should not be situated too far apart for the agreement of the result of such plots is a function of this distance. The practical conclusion to be drawn from this is that in a series, the number of the subjects of experiment should be limited. To this end, comparative experiments of species, for instance, ought to be subdivided into groups, or series, one of the species of the first group being introduced as a control into the second and third groups.

This method of subdivision into series, if accompanied by an increase in the number of repetitions, is the best method of correcting the technique in field experiments (see also the Standard method of HOLSTMARK and LARSEN which is much used in America)

Effect of the season. — It can be seen from the tables that the accuracy of the data obtained in field experiments varies more or less, according to the season. This depends upon the rain that has fallen during the year. More accurate results are obtained when the weather has been favourable and the crop is therefore heavy.

A good deal also depends on the kind of crop grown. Cereals are more easily and exactly harvested than leguminosae. Beetroots are more troublesome than the leguminosae, while the hay harvest is attended by many risks.

Sowing and harvesting — Errors due to variations in the amount of seed used can be prevented by employing seed-drills which are especially suited to experimental work. The average error due to differences in germinating capacity and other accidental causes would be about 2 %.

The method of harvesting and of ascertaining the yield are both very important. In the case of species experiments, or quality experiments with a view to plant-breeding, the whole harvest is gathered. In manurial experiments, WAGNER's method may be adopted. This consists of taking a sample of 5-10 kg. of freshly cut wheat, drying it under shelter, and then weighing and threshing it, the yield being calculated. In this case, the factors of bad weather, and loss by bird attack or theft are not considered. The defect in this system is that only one, instead of 6, similar samples are taken.

Choice of experiment field by means of "blank experiments". — The similar plots are sown and manured alike and harvested separately; any differences that occur are then chiefly due to differences in the soil. This is often a good method for selecting ground suitable for experiment fields.

HOLSTMARK and LARSEN's standard method. — A certain number of plots, termed control plots, are sown with the same species and manured alike; each experimental plot has a control plot adjoining it. The crop of the two plots are compared and any differences are to be attributed to the soil. It is, however, better to use 3 control plots, instead of 1, for each comparison. In this manner, the "ideal" value of the control is obtained and the average error reduced from ± 2.92 to ± 2.03 . This method is much used in Scandinavia and America.

The best results are obtained by combining the Standard method and the method of many repetitions.

To sum up: the author states that species experiments and quality experiments to determine the best plants for breeding, should be conducted differently. The plots ought to be smaller and the parallel plots more in number. VON RUMKER insists on 4 repetitions, the author is not satisfied with fewer than 6. The size of the plots should be:

for cereals, about 15 m².

for leguminosae 25 m².

for beets etc. 25-50 m².

In manurial experiments the plots must be 100 m² and there should be parallel plots separated by sown protecting borders.

Soil treatment experiments require at least 4 parallel plots of about 500 m². Still larger plots are necessary for experiments in soil improvement.

III. — The author has used VON RUMKER's method in comparing 7 kinds of barley: Brunhilda, Eglfinger, Engelen, Streng, Ackermann, Freidrichswerther, and Eckendorfer. In another series of experiments, 8 types of winter wheat were compared: Diva, Traublinger, Bayernkönig, Siegenlander, Engelen, Holzapfel, Elsässer Rot, Baibinger.

The author recognises the great value of VON RUMKER's method for this class of experiment. In Germany, some of the first scientific trials of wheats on a large scale were made by the Deutsche Landwirtschafts Gesellschaft (See: *Arbeiten der D L G.*), but unfortunately, as may be seen from the reports of that Society, the experiments are still too often conducted with only 2, or 3, parallel plots. The author emphasises the great importance of a large number of parallel plots being employed, especially in preliminary experiment.

IV. — The author publishes the results obtained from an experiment with different kinds of potatoes. The experiment from which no new data were obtained, was undertaken with the object of showing that any well-conducted experiment chosen at random suffices to prove the truth of VON RUMKER's theory. The estimate of probabilities, if thoroughly understood and properly carried out, affords a protection against false conclusions. The method of making calculations of this kind is so simple that it can be taught successfully in the Intermediate Schools of Agriculture.

V. — This author's work is confined to selection trials. He is of opinion that it is sufficient to repeat the experiment 4 times using three rows of plots 5 metres in length. In his calculations, he takes the probable error into account.

VI. — In the opinion of this author, increasing the length of the plots does much more to decrease the errors than increasing the width of the plots. Great importance is attached to the number of parallels and it is considered that in comparative experiments of yield, the error cannot be less than 6 % unless 8-16 parallel plots are employed.

VII. — The author questions whether GAUSZ's theory which is applicable to the minute measurements required by astronomy and geodesy

is equally suitable to agricultural experiments. He doubts how far the labour involved in making the calculations is justified by the results and considers that the object in view, viz., the classification of different types of plant according to their quality could equally well be attained if the calculations were considerably simplified. His remarks are made with special reference to VON RUMKER's "Simple Rules for Non-Mathematicians" (*Fühlings Landwirtschaftliche Zeitung* 1921, pp. 458-461) which he regards as far too complicated for practical use.

When it is a question of a series of experiments undertaken for a single purpose (for instance, the yield of a certain species of wheat grown on different plots), the less the difference between the results, the more nearly will they approach the "normal", that is to say, not only is the yield itself important, but the degree of fixity is also be taken into account in estimating the quality of a wheat.

It is very easy to calculate the normal yield; all that is needed is to take the arithmetical average. To determine the fixity is a more complicated process. Some of the deviations from the mean will be positive and others negative. On taking the squares of the deviations, the negative signs disappear and the sum of the squares varies inversely with the degree of fixity. This sum depends upon the number of the experiments. In order to have a general measure of the fixity, it is thus necessary to divide by this number and afterwards extract the square root of the quotient obtained. This gives the "mean deviation of the arithmetical mean" which is a measure of the stability and renders inevitable the "probable error". This method has already been employed in biology.

To still further simplify the calculation of the mean deviation, the sum of all the deviations — irrespective of the signs — may be found and divided by the number of experiments. This value can also be taken as a measure of fixity but it is less obvious.

The author explains his theory by giving an instance from VON RUMKER's work on the classification of 36 species of beets.

Species I.

Yields	Absolute deviations	Squares of deviations
103.4	25.2	635.04
103.9	24.7	610.09
69.7	9.5	90.25
73.8	5.4	29.16
64.5	14.7	216.09
59.1	20.1	404.01
Average . . 79.2	Sum . . . 99.6	Sum . . . 1 988.64

Average deviation . . .	$\left\{ \begin{array}{l} \sqrt{\frac{1\ 984.64}{6}} = 18.18 \\ \frac{99.6}{6} = 16.60 \end{array} \right.$

Species 6.

Yields	Absolute deviations	Squares of deviations
85.8	22.7	515.29
80.2	17.1	292.41
58.2	4.9	24.91
52.0	11.1	123.21
53.0	11.1	123.21
50.3	12.8	163.84
Average . . . 63.1	Sum . . . 79.7	Sum . . . 1241.97
$\left. \begin{array}{l} \text{Average deviation . . .} \\ \text{Average deviation . . .} \end{array} \right\} \begin{array}{l} \sqrt{\frac{1241.97}{6}} = 14.38 \\ \frac{79.7}{6} = 13.28 \end{array}$		

Whichever of these average deviations is taken, the result will be the same.

Species 1 is superior to 6 as regards yield, but inferior to it from the standpoint of fixity.

The author subsequently gives the definition of the average deviation from the species average, which is the average deviation spoken of above divided by the square-root of the number of the experiments.

After criticising the work of ALEXANDROWITSCH and of VON RUMKER who have introduced other factors necessitating much calculation, the author concludes as follows:

a) When a single series of experiments has been made for a given end and it is wished to express in figures the result obtained, it is sufficient to give:

1) The arithmetical mean of the results.

2) The degree of fixity as shown by the mean deviation from the average

b) When it is a question of a complex of experiments such as is necessary, for instance, in the classification of a series of species, this work can be considerably simplified. After calculating the average yield of each species and all the deviations from this average, the squares of these deviations are obtained. These values are sufficient to enable all the work to be taken in at one glance.

I. The "averages" thus calculated give information regarding the crop-yielding capacity of the species.

II. From the "sums of the squares" is known the fixity and the stability. The larger the sums of the square the less fixed is the species.

The species are classified according to their yields. If two species have the same "sum of the squares", no change is introduced into this method of classifying them, and even where they show great differences of yield they, as a rule, keep their place although their fixity has to be

taken into account. The only doubtful case is when the yield of two species is nearly the same, then their degree of fixity must be considered, and if the difference is very slight, it must be acknowledged that calculation cannot decide under such circumstances, so the cultivator must make up his mind whether he prefers higher yield, or a greater degree of stability.

The author classified 35 species of beetroot according to their yield alone and his classification in 19 out of the 35 species was exactly the same as that made by ALEXANDROWITCH (based on the most elaborate calculations). Where the two classifications did not agree, the differences were not great, as is shown, by the following example :

Species 15 — average 69.9, average deviation 11.79.

Species 31 — average 68.0 average deviation 9.07.

In such a case, calculation cannot be expected to prove which of the two species is the superior.

All that has been said here respecting the classification of wheats applies equally well to seed trials, manurial experiments, pot cultures and field experiments. D. v. S.

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VIII. — WHITING, A. (Illinois Agric. Exp. Station). Inorganic substances, especially aluminium, in relation to the activities of soil micro-organisms. *Journal of the American Society of Agronomy*, Vol. 15, No. 7 pp. 277-289, bibl. Albany N. Y. 1923.

I. — There are comparatively few data concerning the correspondence between the growth of agricultural crops and the intensity of acidity in

cultivated soils. Recent ecological studies by ATKINS (Relation of the hydrogen-ion concentration of the soil to plant distribution. *Nature*, 5: 80-81, 1921) and by WHERRY (Soil acidity: its nature, measurement and relation to plant distribution (1). *Smithsonian Report for 1920*: 247-268, 1922) indicate however, that there is a somewhat close correspondence between the hydrogen-ion concentration of water extracts of uncultivated soils and the naturally occurring flora. It seems reasonable to expect that in the case of agricultural soils there will be found fairly definite degrees of acidity which are especially suitable for the growth of the different cultivated plants, although this degree of acidity may vary considerably with the type of soil. In fact, thanks to the work of the Rhode Island Experiment Station, there has been available for many years a classification of this general nature.

During the last few years the idea has been growing that a determination of the soluble or "active" aluminium in the soil might give a more reliable indication of the need of liming than a determination of the acidity. It is coming to be generally believed that soluble aluminium is toxic to plants and that the reduced growth of many plants on acid soils is due to the toxicity of the aluminum ions present. The opinion that there is a specific toxicity in the aluminium-ion aside from the acidity which accompanies it is based chiefly on the works of ABBOT, CONNER and SMALLEY, MIYAKE, RUPRECHT and MORSE, HARTWELL and PEMBER, and MIRASOL.

The author passes in review the experiments made by all these investigators and criticises their conclusions. From the investigations that have been conducted thus far, it does not appear to have been established that aluminium salts are toxic to plants in the sense that mercury or copper salts are toxic. The idea that the growth of some plants on acid soils is reduced by the toxicity of the aluminium ion present does not explain the increased growth of other plants on such soils. It seems that the observed facts are better explained by either one of the following view-points:

It may be that the mixture of colloidal materials making up the cellwalls of different roots, function best in mediums of different hydrogenion concentrations. This is largely a speculative matter at present.

Or, it is possible that the good growth of certain plants on an acid soil and the poor growth of other plants on the same soil is simply conditioned by the relative quantities or concentrations of the different mineral nutrients available at this hydrogen ion concentration. There are some data in support of this view-point. The poor growth and chlorotic condition of certain plants on calcareous soils is due, apparently, to the inability of the plant to obtain sufficient iron under these conditions. The availability of the iron in nutrient solutions is frequently a limiting factor in the growth of plants, and this availability in many nutrient solutions is a function of the acidity.

(1) See *R* 1921, Nos. 366, 367. (Ed.)

II. — *Organic toxicity.* The author made a physiological study of the toxic substances in the soil, using the method known as that of biological tests, employing living plants as indicators of the physiological properties of the soil.

A soil may be unsatisfactory either because it supplies some substances *too slowly* to the root surfaces, or because it supplies some substances *too rapidly*.

The toxic substances which the author considers may be either organic or inorganic, non-electrolytic or electrolytic, but they must always be dissolved in the soil solution. It seems to become increasingly evident, as research goes on, that most toxic electrolytes are injurious primarily because of their ions. Only a few kinds of ions lend themselves, as yet, to quantitative study. HAWKINS was able to study copper-ion concentration. Perhaps several other ions have received some special attention, as hydrogen-ion concentration is distinctly a subject for study at present. Hydrogen-ion concentration, whether expressed logarithmically, or in osmotic or other pressure values, is surely important, but other influential conditions should also receive attention.

What has much interested the author in the discussion of "acid" soils, is the curiously unscientific way in which the word *acid* is employed to mean nothing more or less than *toxic*. It is true that many toxic soils have solutions that are acid in reaction, but it does not seem to be generally true that the toxicity of these solutions is proportional to either hydrogen-ion concentration or total acidity. A true picture of toxicity cannot be sketched solely, nor even mainly, with the acidity pencil.

With regard to the origin of toxic substances, it may be said that in some cases the poisons may develop directly from the decomposition of soil materials; or they may be brought from a distance and added to the soil. Thus sugars, celluloses, fats, resins, proteins, etc. are continually added to the soil by the activities and final death of plants and animals. The organic poisons generally arise only after partial decomposition of these materials. Such decompositions are common in soils, through the metabolic activities of fungi, bacteria, protozoa, etc. Dead roots, leaves, bark fragments, etc. may readily give rise to poisons in that way.

STOKLASA's finding that living roots ordinarily give off almost nothing but carbon dioxide, but that these same roots give off organic acids such as tartaric, oxalic, etc., when the oxygen supplying power of the soil is very low, seems to be consistent with what we know about respiration and it appears to supply a basis for a possible explanation of the origin of some toxic substances in some soils. Most organic poisons arise from more or less thoroughly anaerobic respiration — that is — from fermentation. Poorly aerated soils, are apt to be toxic.

Soils in which water stands for long periods, are often toxic. Subsoils are usually toxic where the superficial soil layers are usually moist and where there is inadequate subterranean drainage. Anything that lowers the oxygen-supplying power of the soil, tends to produce the toxic condition.

The HUTCHINS methods for determining oxygen-supplying power, by direct measurement, will probably become of special value in connec-

tion with the dynamic consideration of soil toxicity, as well as in many other physiological and ecological connections.

III. — The investigation of infertile soils from various parts of the United States has received considerable attention. Some studies showed that the harmful influence of the extract from infertile soils can be removed therefrom by certain treatments such as boiling, distilling, or removal by means of absorbing agents like carbon black, ferric hydrate, or other finely divided bodies having an absorptive power. It can also be removed by evaporating to dryness and igniting the residue, or by processes which promote oxydation.

The general properties shown by these soil extracts not only pointed to the presence of a body harmful to plant development, but indicated also that the compound is organic rather than mineral. Several organic compounds have been isolated from such soils, which have quite different chemical properties, thus showing that there is a difference in the nature of the chemical compounds in different soils.

The organic compounds which have been found to occur in soil organic matter affect plants differently, some are beneficial to plant life, others are inimical to proper plant development, and still others have no effect on plant growth. In every soil there exists a balance of these two contending influences, the good and the bad. Whether one or the other predominates is due to soil conditions, drainage, composition, plant occupation, etc., which can be influenced by soil management such as tillage, cultivation, drainage, liming, fertilization and by crop rotation, all of which influence the biochemical factors in soil.

Among the substances harmful to plants the following should receive special mention, as having been found in unproductive soils: Picoline carboxylic acid (moderately toxic, nitrogen in this compound is not available to plants).

Dihydroxystearic acid (destroys almost entirely the normal oxidizing power of plant roots).

Salicylic aldehyde (even more toxic, it is a strong antiseptic, inhibiting the action of bacteria).

Vanillin (an aldehyde and thus a reducing agent. It disappears in well aerated soils).

The author calls special attention to the occurrence of aldehydes in soils and to the facts that aldehydes are almost universally toxic to living cells, and further that aldehydes yield acids on oxidation. Aldehydes may, therefore, be present in any soil that shows acidity. (It is fairly simple in any given case to test the soil for the presence of aldehydes). With active oxidation in the soil all aldehydes will vanish and in many cases even the organic acid resulting therefrom may be destroyed. Liming neutralizes, but also promotes the oxidation.

A remarkable fact in connection with one soil was that it contained a large amount of mannite, as much as 500 pounds per acre. The remarkable part lies in the fact that it should persist in the soil, when it is such an excellent medium for the development of bacteria. The simultaneous presence of salicylic aldehyde (poisonous to higher plants) suggest-

ed that the mannite in the soil was protected by the antiseptic action of the aldehyde. This case is particularly interesting as showing that soil compounds affect the lower life of the soil as well as the higher plant life, and through these the entire biochemical processes.

The occurrence of certain compounds in soils thus becomes a direct agent in the diagnosis of soil troubles.

The chief aim in improving infertile soils should be to build them up so that they will become good oxidizers and through this become strong and virile soils.

It has been possible to observe the disappearance of toxic soil conditions by thorough aeration and exposure to air by the action of lime and oxidizing fertilizers like sodium nitrate, or the influence of oxidizing substances like manganese.

IV. — *Inorganic toxicity.* It is pointed out by the author that the intensity of acidity, as determined by hydrogen-ion concentration determinations, bears, in general no direct or simple relation to the quantity of acid present in the soil. It has been shown that the intensity of the acidity in many instances is of greater significance in biochemical processes than is the quantity of acid present.

The author gives some data for the tolerance of acidity by bacteria in soils.

V. — *Toxicity due to aluminum.* During the past 25 years much has been written about acid soils and many causes of this unfavorable condition have been suggested, but with all that has been said and done there is not yet unanimity of opinion as to the cause of acidity, nor as to the identity of the substances which produce the toxic effects. Mineral and organic acids, acid salts, soluble aluminum compounds, the removal of basic materials by crops and by drainage waters have been suggested as causes of unproductive acid soils. Recently, considerable attention has been given to soluble aluminium salts as a possible cause of much of the trouble heretofore attributed to "acidity".

The author describes some work done in this direction at the New Jersey station.

Soils which had become toxic through more or less abnormal treatment were leached with distilled water and the leachings analyzed for soluble iron and aluminium and other constituents, and were also used as culture media for the growing of plants. In growing the plants, portions of the extract were used unmodified, and other portions were modified by the addition of soluble phosphates, lime water and by adding ammonia, boiling and filtering to remove soluble iron and aluminium. Normal soils were also extracted and the extract used in comparison with the extract from the toxic soil. The analyses of the extracts from the good and poor soil brought out differences in soil reaction, water holding capacity, total nitrogen and carbon, and water-soluble iron and aluminium.

The culture-solution work makes it very clear that there is something in the extract from the toxic soil which interferes with root development of the plants. The extract from the normal soil gave normal root development, as did the standard culture-solution.

Addition of nitrate of soda and small amounts of soluble phosphates to the extract from the toxic soil, did not correct the unfavorable condition to an appreciable extent.

When the toxic extract was boiled with ammonium hydroxide, filtered and a trace of iron and phosphoric acid added to the filtered solution, normal root and top growth were obtained.

That this improvement was not due entirely to the neutralizing of the acidity is shown by the fact that the standard control solution, which gave normal root growth, had a pH value approximately the same as the pH value of the toxic extract. Aluminium sulphate when added to normal culture solutions in amounts equivalent to, and greater than the Al_2O_3 present in the unmodified toxic extract, gave results similar to those with the unmodified extract. The pH values of the solutions were lowered by the addition of aluminium sulphate, but culture solutions of identically the same pH with sulphuric acid, produced plants much healthier in appearance than the cultures receiving the aluminium sulphate treatment. The results of the work point strongly to soluble aluminium as being responsible in part at least, for the unhealthy root development.

Vegetation tests carried out in small glazed earthenware pots gave results which confirm, in a large measure the culture-solution results. In the pot tests, however, heavy applications of acid phosphate to the toxic soil resulted in a great improvement in growth, even when the pH value was as low as 5. Small applications of ground limestone and basic slag, gave good results in the pot experiments.

When aluminium compounds were introduced without a basic material such as lime, the yields were reduced to less than the yields with the untreated soil (check), but in the presence of liberal applications of basic materials, the aluminium sulphate and aluminium nitrate did not appreciably lower the yields of dry matter as compared with the yields from the basic materials without aluminium compounds.

The result of the pot work also leads one to suspect that soluble aluminium compounds constitute one of the causes of toxicity in soils.

The results of the work indicate that such toxicity may be largely overcome by heavy applications of soluble phosphates or by application of basic materials such as the different forms of lime and basic slag.

VI. — For many years the Rhode Island station has been studying the effects of "acid-soil" conditions, and more recently, of certain toxic substances, resulting from or accompanying soil acidity.

The presence of toxic concentrations of "active" aluminium salts in the acid, granitic soils under investigation has been studied (see HARTWELL and PEMBEK). In this paper the author describes a method for the determination of "active" aluminium in acid soils.

A full account of the work of the station on aluminium toxicity to plants and its possible correction, will appear in a future publication from this station.

VII. — The biological role of aluminium and iron compounds is being studied by many investigators with special reference to the effects

of these metals : a) on acidity of soil ; b) on the absorption of essential nutrients by plants ; and c) on the functioning of the tissues of the plants after the metals have been absorbed. This paper considers only those effects upon the maize plants resulting from the absorption of these metals and the probable relation of these phenomena to the susceptibility of maize plants to root-rots.

One of the most characteristic differences between normally growing maize plants and those which become severely root-rotted, is the condition of the vascular plate tissues in the nodes of the stalks. The plants which become root-rotted are those which have the nodal tissues discolored and in various stages of disintegration. This disintegration of the nodal plate tissues begins in the absence of any specific organisms in the tissues.

The brown, yellowish brown, and brownish purple discolorations with their consequent disintegration which are frequently found in diseased plants have been produced artificially by injecting solutions of certain salts of aluminium and iron into the plants. Definite chlorophyll and leaf-tissue changes have been produced also.

The most severe cases of root-rots have been found in soils notable because of their deficiencies of lime and available phosphates. Such soils have variable quantities of salts of aluminium and iron available for absorption by plants.

The accumulations of aluminium in the plants are associated with retarded growths and increased susceptibility of certain strains to root-rots. When iron compounds gradually accumulate in the nodal tissues of the plants, the growth of the stalks may be little affected, but the disintegrations of the nodal tissues are accompanied by increased susceptibilities of the plants to root-rot.

When abundant aluminium injuries occur in the maize plants in certain fields, it is an indication that the soil is deficient in available phosphates.

VIII. -- This paper is limited chiefly to the recent work on aluminium, which has been conducted in the United States. The author gives information on the work done in the following states :

Indiana, Massachusetts, Rhode Island, Illinois, Hawaii, Iowa, Utah, Alabama (experiments on manganese), Ohio and Wisconsin. He then gives a summary of concordant results, as follows :

Soluble salts of aluminium have been found by a number of investigators in acid soils which have been treated with soluble salts of other metals.

Aluminium in soluble form is found in soils where sulphur is being oxidized. Sulphuric acid and sulphates are present and act on the aluminium.

Calcium carbonate has been found to prevent the injurious action of aluminium. Aluminium associated with hydrolyzable and highly ionizable salts has been shown to exert a toxic influence on plants aside from the acidic effect of the associated acid radical.

Aluminium phosphates have been shown to be excellent sources of

phosphorus for a number of agricultural plants in spite of the aluminium present.

Soils that have not been treated with salts show practically no soluble aluminium in clear water extracts.

The form of aluminium first extracted by normal potassium nitrate in aqueous solution is non diffusable and appears to be a colloidal form of aluminium hydroxide.

Practically all acid soils which have been studied contain quantities of easily replacable aluminium when brought in contact with salt solutions.

Certain acid soils contain large amounts of soluble manganese and this element appears to support nitrification. Soluble manganese occurs in soils as a result of sulphate oxidation.

There is available information which indicates that the use of moderate amounts of liming materials and ample quantities of phosphates will precipitate the toxic forms of aluminium, iron and manganese, in acid soils and at the same time allow the establishment of pH values in keeping with the requirements of soil organisms, the growth and feeding power of crops and their response to feeding. It has been shown that attention to the above considerations makes possible the production of maximum quantities of nitrates and a large symbiotic nitrogen fixation.

Results requiring verification. Aluminium has not yet been shown to be a suitable base for the process of nitrification. Until this has been done, this biological process cannot be considered a primary cause of increasing soil acidity.

Soluble aluminium has been found to be present, where the bacterial oxidation of sulphur is in progress. The possibility that sulphate formation is a factor which contributes to an increase in soil toxicity is a subject for further investigation.

There is no analogy between nitrification and sulphate formation, either from the standpoint of the acidity endured by the organisms concerned, or the requirements for a base. The two processes may, however, be analogous with respect to the action of the ammonium salts produced, each giving rise to secondary decomposition with consequent production of soluble aluminium.

The influence of aluminium as a toxin to soil organisms does not appear to be important when optimum quantities of phosphorus, potassium and calcium are supplied. Studies concerned with this question have not been sufficiently extensive, to allow of a general conclusion, and other species of bacteria should be studied.

Aluminium hydroxide has not been found to be toxic under normal conditions of experimentation. However, the insoluble hydroxide cannot be considered as representative of the forms of aluminium which are likely to be met with under soil conditions. Since it is a weak base, its toxicity would appear to be related to its action in precipitating phosphorus and calcium in the soil solution and in the cells of plants and micro-organisms, and in the precipitation and formation of certain organic compounds which cause abnormal functioning of living cells. It may

also rob plants of potassium through losses by leaching of the potassium aluminate. Aluminium hydroxide or the hydrosol of aluminium hydroxide has been reported as the form of aluminium produced by replacement with salt solutions. The influence of the pH values on the solubility of this compound have shown that increasing quantities should be found with increasing concentration of hydrogen-ion below $\text{pH} = 6$ and that appreciable quantities of aluminium hydroxide are in solution at $\text{pH} = 8$ and above. Thus, the injury which is sometimes noted where hydrated lime or excessive quantities of carbonates have been applied may be due in part to the toxicity of the aluminium ion.

Points in need of immediate investigation. - The soluble but replaceable forms of aluminium, iron and manganese present in acid soils should be identified, in order that definite information may be available as to the origin of the toxic and acidic aluminium, iron and manganese. The recognised ability of many crops to feed on insoluble minerals makes it unnecessary to assume that aluminium must be in solution in order for it to be toxic to, or assimilated by, organisms.

The importance of optimum quantities of phosphorus and potassium in counteracting the toxic effect of these elements in the soil and in organisms needs careful consideration.

Organic matter has been neglected as a possible detoxicating factor with respect to the forms of these elements that depress the growth of organisms and plants.

In conclusion, it can be said that the gradual development of toxic conditions is generally accompanied by a gradual reduction of non-toxic available bases in the soil. The conditions are aggravated, as far as crops and organisms are concerned, by a scarcity of certain essential elements, particularly phosphorus and potassium. D. v. S.

533. Life History of Azotobacter.

I -- LOHNIS, F. and SMITH, N. B., Studies upon the Life Cycles of the Bacteria, Part II, Life History of Azotobacter, *Journal of Agricultural Research*, Vol. XXIII, No. 6, pp. 401-432, 9 pl., bibl., Washington, 1923.

II -- HUNTER, O. W. Stimulating the growth of Azotobacter by Aeration, *Ibidem*, Vol. XXIII, No. 8, pp. 665-677, 4 fig. bibl. 1923.

III -- IDEM, Production of a Growth-promoting Substance by Azotobacter, *Ibidem*, Vol. XXIII, No. 10, p. 825-831, fig. 2, bibl., 1923.

IV -- IDEM. Protein Synthesis by Azotobacter. *Ibidem*, Vol. XXIV, No. 3, pp. 263-273, bibl., 1923.

V -- GAINFY, P. L., On the Use of Calcium carbonate in the Nitrogen-fixation Experiments. *Ibidem* Vol. XXIV, No. 2, pp. 185-190, bibl., 1923.

In a preliminary communication published in the *Journal of Agricultural Research* Vol. 6, No. 18; pp. 675-702, 1916, the author pointed out, that the life history of Azotobacter is much more complicated than was generally assumed, and that the same holds true with regard to all other bacteria. The correctness of this general statement was further demonstrated by the same author in a critical review of the bacteriological literature.

ture, published as Part I of these Studies (Studies upon the life Cycles of the Bacteria. Part I, Review of the literature 1838-1918. *Mem. Nat. Acad. Sci.*, Vol. 1, No. 2, 335 p.).

To obtain complete and actual information upon the life cycles of the bacteria is no more difficult, but takes much more time than to make an ordinary bacteriological diagnosis. Single-cell cultures and continuous microscopic observation of the living organisms are by no means so absolutely indispensable as is sometimes asserted. The usual methods of isolating, cultivating, and studying the bacteria are, as a rule, quite sufficient to collect complete information, provided they are applied judiciously and the investigator himself is not too pre-occupied by the wide spread prejudices concerning "normal" and "abnormal" growth, "involution forms" and "contamination". A sufficient number of parallel tests, the frequently repeated microscopic control of the cultures, held for a sufficient length of time (not less than a month, preferably longer), and the regular repetition of all experiments are three points of major importance.

Tests made with 30 strains of *Azotobacter* and with several cultures of related bacteria have shown that only two species of *Azotobacter* are completely characterised thus far: *Azotobacter chroococcum* and *A. agilis* Beij. (syn. *A. Vinlandii* J. G. Lipman). *A. Beyerinkii* J. G. Lipman is a variety of *A. chroococcum* and *A. vitreum* Löhnis, is probably a variety of *A. agilis* - *A. Smyrni* C. B. Lipman and Burgess and cannot be accepted as a species; according to all marks ascribed to it by its authors it is the large sporulating growth type of *A. chroococcum* - *A. Hilgardi* C. B. Lipman and *A. Woodstounii* J. G. Lipman, both of which are incompletely described and should not be retained.

Each of the 30 *Azotobacter* strains was tested in about 100 to 200 transfers, the results presented in this paper are based on over 20,000 observations.

The thorough study of the problem of the life cycle of *Azotobacter*, led to the discovery that from every *Azotobacter* culture not less than seven different growth types can be developed and stabilised; all of them are interchangeable. These are: 1) Large non-sporulating cells; 2) coccoid forms; 3) dwarfed cell type; 4) fungoid cell type; 5) small non-sporulating rods; 6) sporulating rods; 7) large sporulating cells.

Identical with 2) are: *Micrococcus concentricus* Zimm., *Micrococcus sulfureus* Zimm., Lehm., and Neum., and *Micrococcus roseus* (Bunn.) Lehm. and Neum. respectively.

Identical with 4) are: *Mycobacterium luteum* Söhlngen, *Mycobacterium laticola* Lehm. and Neum., *Mycobacterium album* Söhlngen.

Identical with 5) are: *Bacterium lactis viscosum* (Adanetz) Lehm. and Neum. and *Bacterium putridum* (Flügge) Lehm. and Neum.

Identical with 6) are: *Bacillus terminalis* Mig., *Bacillus fusiformis* A. M. and Gottheil, *Bacillus pumilus* A. M. and Gottheil.

Identical with 7) are: *Bacillus luteus* Baker and Smith, *Bacillus petasites* A. M. and Gottheil, *Bacillus malabarensis* Löhnis and Pillai and *Bacillus danicus* Löhnis and Westernman.

All types of bacterial reproductive organs have been found with *Azotobacter*, namely gonidia and gonidangia, regenerative bodies (zoospores etc.), arthrospores, microcysts, endospores and exospores. All these organs of reproduction are fundamentally not so different as might be assumed.

The formation of the symplasm and the regeneration of new cells from this more or less amorphous substance of varying stainability, proceeds with *Azotobacter* in the same manner as with all other bacteria.

Conjunction was regularly seen in young cultures before the formation of gonidia, regenerative bodies, and exospores and endospores took place. Part of the regenerative bodies are clearly zygo-spores. The cell union is either temporary, effected by connecting beaks, bridges, or by direct contact of two or more cells, or permanent, due either to a sticking together of two uniform cells, which retain their identity, or to a coalescence of two cells of more or less different appearance. These various modes of conjunction, observed with *Azotobacter* as with other bacteria, resemble very closely those recorded with yeasts and with protozoa.

The fact that the different developmental stages of *Azotobacter* could be in part identified with certain so-called species belonging to the form genera *Micrococcus*, *Bacterium*, *Pseudomonas*, *Bacillus* and *Mycobacterium*, demonstrates anew and conclusively that the whole system of bacteria needs complete revision, which is to be based upon the results of thorough examination of the life histories of the bacteria.

The author has illustrated his paper with 9 photographic plates (108 figures) of microscopical observations, all carefully described.

II. — The theory of SÖHNGEN that the BEIJERINCK medium lacks only nitrogen and oxygen is here supported. Observations suggest that both these elements can be supplied by aerating the culture medium and that thereby a rapid and vigorous growth of *Azotobacter* can be promoted. Aeration also stimulates rapid nitrogen fixation by *Azotobacter*.

The ability of *Azotobacter* to fix nitrogen is dependent upon the energy derived from carbohydrate fermentation. In the aerated cultures the consumption of dextrose is very rapid. The presence of calcium carbonate is not essential in a medium used for aerating pure cultures of *Azotobacter*.

III. — It is maintained by many investigators that the animal cell is incapable of synthesizing vitamins and that such cells are thus required to obtain their food accessories from the vegetable kingdom. If this is true, it can be logically asked, do plants need such growth promoting factors? If so, do they synthesize them or from what source are they obtained? The application of the vitamin theory to microbial nutrition is now prevalent. PACINI and RUSSELL, from their experiments concluded that *Bacillus thyphosus* Eberth-Gaffky can manufacture vitamins and likewise stimulate growth of the animal cell.

If a growth-promoting substance is a requirement for *Azotobacter* development, it is capable of manufacturing such. The *Azotobacter* can synthesize a food accessory factor. This food accessory factor stim-

ulated a greater net gain in white rats than did baker's yeast. *Azotobacter* exerts a pronounced curative effect upon pigeons effected with polyneuritis.

IV. - The high protein content of the *Azotobacter* cell and its relatively simple food requirements suggested the possibility of utilizing it as a means for synthesizing a protein which could be used either as a stock food or a fertilizer. The employment of this organism for such a purpose appeared to offer some important advantages on account of its nitrogen-assimilating ability. This would necessitate the use of a solution having a carbohydrate only as the important constituent. The protein content of *Azotobacter* growth obtained from a solid medium was found to be 11.81 %, while that collected from a liquid culture was 30.65 %.

The yield of cells increased with the quantity of dextrose in the medium. When molasses was used as a source of energy for *Azotobacter* development, there was obtained a yield of cells equal to 30.44 % of the sugar in the molasses. *Azotobacter* is able to convert the soluble nitrogenous substances present in molasses into more complex protein, as well as to utilize the molasses as a source of energy for the fixation of atmospheric nitrogen.

The addition of straw to the dextrose or molasses medium did not cause any appreciable increase in the quantity of nitrogen fixed.

V. In reviewing the literature on nitrogen fixation by soil bacteria, the author was impressed with the great variety of media that have been employed by different investigators. The author calls attention to the difference caused by the presence or absence of calcium carbonate. He then describes media used by WINOGRADSKY, BENJERINCK, LIPMAN, ASHBY, LOHNIS, and his students. It remained for STOKLASA to produce the necessary evidence for a correct understanding of the function of calcium carbonate in nitrogen fixation experiments by demonstrating quantitatively the formation of organic acids in cultures of *Azotobacter*.

The medium employed by the author had the following composition

Mannite 20 gm., K_2HPO_4 0.2 gm., $MgSO_4$ 0.2 gm., NaCl 0.5 gm. $FeCl_3$ trace and 1000 cc. water. Several hundred samples of soil from Kansas and other States have been examined. He concludes from his experiments that the quantity of nitrogen fixed in the presence of *Azotobacter* is greater than when it fails to develop. The number of soils capable of initiating the growth of *Azotobacter* under the experimental conditions here described is greater by 20 %, if calcium carbonate is added to the medium than if it is omitted. The quantity of nitrogen fixed in a medium containing calcium carbonate is, for practical purposes always equal to and in most cases greater than when calcium carbonate is not present in the medium. The presence of calcium carbonate exerts a greater beneficial effect upon those organisms, other than *Azotobacter*, that bring about the fixation of nitrogen, than upon *Azotobacter* itself.

D. V. S.

*Pedology.*534. **Soil Structure and Colloids.**

HAGER, G. Bodenstruktur und Kolloidchemie. *Zeitschrift für Pflanzenernährung und Düngung (wissenschaftlicher Teil)*, Vol. II, No. 4, pp. 292-311, fig. 1. Leipzig-Berlin, 1923.

The chemistry of the colloids is a recent science, but it promises to become of great importance to agricultural chemistry and pedology.

The correction of soil structure by liming makes ploughing easier, and although the surface dries quickly, the lower layers of the soil retain water and remain moist.

Chili nitrate and potash salts bind together clayey soils making them more difficult to plough, and reduce their aeration and water-retaining capacity. Land flooded by the sea is rendered useless for years, even after the salt-water has been washed out by the rain. All the alteration in the soil which we have already mentioned, and also many others, are occasioned by changes in the colloids of the soil, viz., the soil particles which are in a colloidal condition.

Colloids are distinguished from suspensions and molecular solutions by the degree of their dispersion. The term colloid is confined to particles below 0.0002 mm. being called colloidal clay according to the nomenclature adopted by the International Commission. Among the colloids are classed the "gels", known in ordinary chemistry as aqueous silicates of alumina, and in colloidal chemistry, by the name of absorbant compounds.

The author draws attention to the fact that, in soil analysis, the determination of the size of the particles is not sufficient, for much depends upon whether the particles are flocculated "gels", or granular bodies.

All inorganic gels have a high water content, and readily absorb the hydroxyl ions. The author mentions in this connection the work of several authors such as ZSIGMONDY, KAPPEN, WIEGNER, KING, MATTSON and others, and summarises their conclusions as follows:

The particles of granular structure disintegrate as a result of the various reactions that increase the degree of dispersion of the soil. The coagulated colloids, which often envelop the particles, are dissolved to some extent, but largely decompose and become gelatinous and viscous. Further, they absorb water. All these factors help to form the soil into clods which hinder ploughing.

Under the influence of all the factors that tend to diminish the degree of the dispersion of the soil, the coagulated colloids become granular, while the colloids present in the soil solution are coagulated. The particles are reduced in volume, and the structure of the soil is improved.

The author then reviews the causes believed to produce "peptisation" and "coagulation", but many questions connected with these subjects are yet unsolved.

It, however, remains a fact that lime and calcium carbonate improve

the structure of the soil, whereas neutral salts such as sea-salt, potash salts and Chili nitrate have a deleterious effect.

The effect of the ions seems to be much greater than has hitherto been supposed. Changes in electric potentials, superficial tension and chemical reactions are the causes of the phenomena of peptisation and coagulation. The author understands by adsorption, all kinds of reactions in which surface plays any part. The higher the degree of dispersion, the greater the surface extension and the greater the reaction of superficial molecules.

The alkaline bases and alkaline earths (Na OH , KOH , and Ca (OH)_2 as well as their carbonates), are of considerable importance in the soil because they change the degree of dispersion as the result of the absorption of the hydroxyl ions by the colloids. The electric forces that come into play induce precipitation. Thus, liming makes the structure of the soil more granular.

Neutral salts, like Na Cl , and K Cl , have the contrary effect. The zeoliths of the soil contain much lime in an exchangeable form. Therefore when sodium chloride is introduced (by flooding with sea water), or potassium chloride (in a fertiliser), an exchange of bases will take place with the formation of sodium zeoliths that are very easily decomposed. Afterwards, soluble compounds quickly removed by the rain are formed, and the soil becomes hard, impermeable and caked. As a result of the degree of dispersion being increased, hard-pan may be produced. In the opinion of the author, it is not the magnesia present in the potash fertilisers that produces these crusts, as is commonly supposed.

Nitrate of soda may have the same injurious effect as the above salts. The plants absorb the nitrogen and leave the soda which forms sodium carbonate, a solvent of humic substances. In this case also, the degree of dispersion is increased, and the structure of the soil is altered for the worse.

D. v. S.

535 Removal of Salts from Soils in Egypt.

MOSSERI VICTOR M. and AUDEBEAU BLY CH. Du rôle des crevasses au sol dans le dessalement et l'assainissement permanents des terres d'Égypte. *Séance Agric. Society, Bulletin*, No. 11, p. 11, Plates 1. Cairo, 1925.

M. MOSSERI has shown in a previous paper (*Le drainage en Égypte, Bulletin de l'Institut Égyptien*, 1909), that when more or less saline soils crack and become fissured under the action of heat and drought, the salts they contain are concentrated to a great extent on the surface of the clods while the fissured parts behave like rocks that are permeable on a large scale. These facts explain why it is better in the case of soils that crack, to remove the salt by means of open ditches rather than by under ground pipes (or drainage properly so-called).

During the *sheragi* period (the hot months), the soil cracks and fissures in all directions, thus making deep channels that form a complete and natural system of aeration as the air passes down them to considerable depths, and is distributed along vertical and horizontal planes.

Flood Basins. -- For several thousands of years, the whole of Egypt was irrigated by flood-basins which became full of *red water* during the months of the annual rise of the river, and emptied themselves either into the Nile itself, or into the lakes bordering the Mediterranean, before the winter crops (cereals, leguminosae, flax, etc.) were sown, that is to say, at the end of October, or the beginning of November. The water remained in these basins for 50 to 70 days, and usually reached a depth of 1.50 m.

During the XIX century, however, irrigation by flood basins was abandoned in the Delta and became superseded by perennial irrigation. In Middle Egypt, the construction of the Assouan reservoir led to the conversion of part of the basins early in the XX century, but the old irrigation system still exists in Upper Egypt. In these basins the precipitation of matter in suspension in the water naturally takes place in decreasing order of its density, so that the soils furthest from the river are generally the most clayey, some of them containing as much as 90% of clay.

Temperature of the air and soil. The author gives a table showing the average temperatures of air and soil in the Delta, Middle Egypt and Upper Egypt respectively during the period intervening between the time when winter crops are carried (April-May) and the date of the annual rise of the Nile (August-September).

Maximum temperatures of air	34	40	C
Minimum temperatures of air	16	25	C

Maximum temperature of air at surface of soil 55°-70° C. The highest temperatures are found in Upper Egypt. The average evaporation in 24 hours for the same period varies from 4 ½ mm. to 13 ½ mm. (Wheeler's evaporimeter).

Level of subterranean water. - In Upper and Middle Egypt, the natural level of the subterranean water remains very low from April to August (about 4 to 5 metres below the soil in April, and from 5 to 7.50 metres towards the end of July). This depth decreases on passing from Cairo in a northerly direction. In the northern districts, the natural water-table remains at a considerable depth in the subsoil, whereas the artificial water level due to the lack of any soil slope is met with quite near the surface (0.50 m. to 1.20 m.).

Fissuring of the soil. - Although the soils of Upper Egypt are less clayey than those of the north of the Delta, they contract more under the influence of higher temperature, more intense evaporation and the lower level of the water-table. The cracks assume polygonal figures on the surface, their depth varies from 0.25 m. to 1.50 m. These fissures grow increasingly narrow and give rise to channels ramifying in all directions, which become reduced to the width of capillary tubes. In 1918, the author had the width and depth of 52 large fissures over an area of 15 sq. metres measured every 5 days in the region of Sakha (centre of the Delta). These measurements showed that the fissures increased much less in depth than in width from May to July. The maximum depth is practically reached in the second half of May.

The river water contains in solution a large amount of salts, chiefly chlorides, the salt content is at its minimum during the annual rise of the river (120 to 125 mg. per litre, 2.5 to 3.5 mg. being chlorides), and attains its maximum when the Nile is at its lowest (135 to 260 mg. per litre, of which 20-20 are chlorides). Although the percentage of injurious salts is very little at the time the basins are filled it would, however, render the soil completely sterile in the course of years unless the salts were leached out and carried away to the sea. The soils are freed from salts by the epipolydric and bathydric processes.

The water-holding capacity of ordinary, dry alluvial soils varies in volume from 50 to 55 %, when these same soils are saturated, the volume of water they contain ranges from 60 to 65 %. Some of this water passes down slowly into the subsoil and takes its course to the sea, either directly, or by way of the Nile, when the level of that river is sufficiently low. This is the bathydric process. The water in its passage through the soil dissolves the salts along its course and thoroughly washes the soil. The salt content of such water is much higher than that of Nile water (See V. MOSSERI, *L'Utilisation du réservoir souterrain de l'Égypte*, *Bulletin de l'Inst. Égyptien*, Series V, Vol. VIII). In the northern part of the Delta, the soil cannot be washed by the bathydric process, since the strata of plastic clay prevent there being any communication between the upper soil and the deeply-seated sands. In the centre and south of the Delta, as well as in Middle and Upper Egypt, the leaching is more thorough because the alluvium is more permeable. In regions where perennial irrigation has replaced the basin system, the permeable soil is not so well washed.

The water that is not lost in the deeper strata remains in the soil whence it is abstracted by plants, or liberated by evaporation. The water moves by capillary attraction, and on reaching the surface of the ground, or the sides of the fissures, evaporates leaving behind it the salts, and especially the chlorides. The amount of salt per unit of surface area becomes very large on these surfaces.

Subsequently, during the filling of the basins, the injurious salts are dissolved in a large volume of water and conveyed to the Nile as soon as

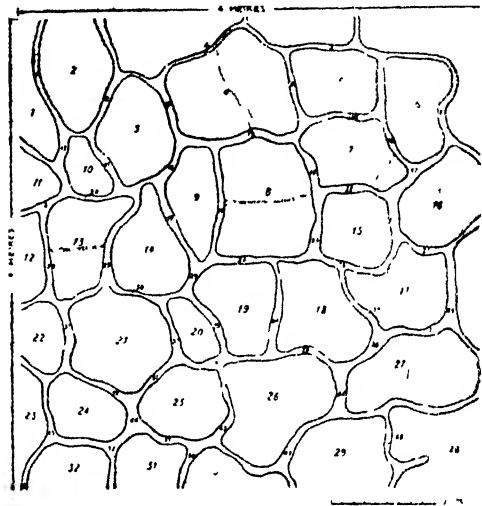


FIG. 99. — Soil crevices in the Sakha area measured in 1918.
(intervening crevices not included)

Indian Bulletin, Vol. XIX, 1922, p. 126) would appear to prove that linear contraction is regulated by two opposing factors: 1) the amount of the dispersion of the soil particles which determines the amount of moisture present at the maximum degree of plasticity; 2) the extent of the aggregation of the particles which depends on the proportion of this moisture that evaporates when the shrinkage ceases.

The fissuring of the ground was one of the most efficient factors in maintaining soil fertility under the old system of basin irrigation. The advantages of the *Sheragi* are manifold; it regulates the removal of the salts, while the fissures carry down the air to considerable depths where it circulates owing to the differences in the temperature. The deep cracks make the ground porous during the *Sheragi* period, the volume occupied by the air in the soil increasing at least 35 to 40 %. This volume may reach, or exceed, the values found in the case of soils artificially broken up by the plough. The *Sheragi* allows the flood waters to penetrate to a great depth in the soil, but it also insures their rapid and regular distribution, as well as making it possible for the soil to store up a large quantity of water. Rain and artificial irrigation cause the soil to cake gradually (see diagram), which renders infiltration difficult and checks the distribution of moisture. The more clayey the soil, the greater its tendency to cake, and the conditions favourable to plant growth would become increasingly difficult to maintain were it not that the *Sheragi* restores them by breaking up the ground. The clay deposits are frequently so compact that they cannot be cut by plough, in which case they are left until the *Sheragi* has rendered them mellow and in a condition for working after the next inundation.

Effect on the chemical properties — The air circulating in the depths of the earth makes it possible for oxidation processes to take place. In the sub-soil of low-lying, badly aerated ground, the alkaline bicarbonates become transformed into carbonates, but aeration produces the inverse reaction. Under the influence of heat, the colloids investing the minerals become dehydrated and disintegrated, with the result that solutions richer in nutritive substances are produced.

Effects on the biological characters. — Heat and drought have a considerable effect on the amount of nitrification taking place. (See Sir JOHN RUSSELL, *Soil Conditions and Plant Growth*, 4th ed. London, 1921, p. 169). Soils that have been subjected to the action of *Sheragi* show, when once they are irrigated, a more marked bacterial activity than other soils of the same character. *Sheragi* would appear to exercise an effect similar to that produced by partial sterilisation (See PRESCOTT, *A Note on the Sheragi Soils of Egypt. Journal of Agricultural Science*, Vol. X, 1920, p. 177). The improvement produced by partial sterilisation is permanent lasting more than 200 days; it is especially noticeable when the heat is accompanied by continued dryness.

Effects on parasites. — It is certain that the action of the heat and the drought of the *Sheragi* destroy the spores, or eggs, of most of the vegetable, or animal, enemies of cultivated plants. This is of great importance in the case of a valuable crop like cotton which is liable to wilt disease, and root-rot. The *Sheragi* also destroys the vegetation sheltering these parasites.

Inundation. — The average volume of water absorbed per "feddan" in the basin region during an ordinary year has been estimated at 3.950 cubic metres; but the total layer of flood water absorbed by, and evaporated from, these basins is about 1.36 m. which is equal to a total volume of 5.700 m. per "feddan". This is the volume that must be taken as a basis in calculating the amount of substances in solution, or in suspension, that are removed by the water. Submergence does not appear to affect the work of the *Sheragi* to any appreciable extent.

Conclusions. — Since the flooding system has been suppressed, the conditions of production have been profoundly altered and fertility has been progressively affected. The two-years' rotation of the present day has reduced the duration of the *Sheragi* and thereby decreased its advantages. Although economic conditions do not allow of a reversion to the old system, it is necessary to reconcile modern requirements with the necessity of prolonging the *Sheragi* period. The problem can only be solved by a three-years' rotation combined with a careful selection of the crops to be grown. The three-years rotation approaching most nearly to the former conditions would be a system by which after a long summer *sheragi*, *chetoni* cereals follow *bersim*, or some other leguminous crop, of the preceding winter, the rotation being *cotton*, *bersim* (or some legume) — *winter cereal* (wheat or barley), *maize*, *cotton* etc. With this rotation, the winter legumes would be sown after the cotton was gathered or even before the latter was pulled up, if the season were advanced and the leguminous crop were *bersim*. The land is then left bare until the *chetoni* cereals (wheat, barley, etc.) are planted. They can be sown at the proper time in soil rich in nitrogen and thoroughly prepared, as it has been exposed to the beneficial effects of a *sheragi* period of the same length as in the days of basin-irrigation. In districts where rice and sugar-cane are cultivated, special rotations are needed. The advantages of the above rotation are great; it allows the soil to be thoroughly prepared; a complete *sheragi* succeeds one, or two, partial *sheragi*; further, the seeding can be done at the right time. To sum up: soil fatigue is eliminated, the soil is drained and its fertility maintained with the minimum work and expense, labour is considerably reduced, and fewer draught animals are required for agricultural operations; more cattle can be raised, which increase the production of meat, milk and other dairy produce, and also of farmyard manure; weeds and the agents of disease are destroyed. In addition, this system reduces the water-requirements of Egypt which is an immense gain, for the water-supply of the country presents a serious problem that is the subject of much discussion at the present day. D. v. S.

537. Condensation of Water in the Soil.

JAGER GERLINGS. Condensatie van water in den bodem *Tydschrift der Nederlandsche Heerdemaatschappij*. Year 35, No. 9, pp. 314-316. Arnhem (Holland), 1923.

With a view to the reafforestation of the moving sands of Holland, the Sylvicultural Experiment Station of that country has recently estab-

lished a Sub-Station at Stroe (Holland) where experiments are to be carried out on the economy of water in a sandy homogeneous soil of low water-retaining capacity. In the course of these investigations, which are to be continued for some years, it was discovered accidentally that, under certain conditions, water can be condensed and conducted deep down into the ground.

The experiments were carried out in the following manner: 18 boxes (1.5×1.5 and 1 m. deep), were filled with sand (the surface layer in some cases being mixed with clayey soil, lupin straw, or heather), and planted with two-year-old pines.

The surface of some of the boxes was covered, and that of others left exposed. The boxes could easily be placed on a balance. From May 20, 1922, the temperatures of the soil have been taken daily and it has been found that covering the soil has a great effect on temperature variation. These variations were particularly noticeable when the sand was covered with gravel. During a long period when the boxes, were not watered, it was found that while the weight of some of the boxes had decreased, that of the others had clearly increased, the gain in weight being especially marked when the sand had been covered with gravel, though both the boxes that were left uncovered and those in which the upper layer contained lupin straw were also heavier than at the outset of the experiment. This increase in weight must be due to the condensation of water in the soil caused by the rapid cooling of the gravel, and of the upper layer of the sand upon which the water collected. This experiment is likely to be of great importance in the reafforestation of shifting sands. D. V. S.

538. Shrinkage of Clays and Soils.

HARDY F. (West Indian Agricultural College, Trinidad). *The Journal of Agricultural Science*, Vol. XIII, No. 3, pp. 243-261, Bibl. Cambridge, 1923.

The shrinkage coefficient of a soil may be defined as the maximum percentage decrease in length (linear coefficient) or in volume (cubical coefficient) which is shown by a block of the soil that has previously been worked up with to a standard degree of plasticity and then allowed to dry in air.

The author gives a brief outline of the researches of certain workers in the British West Indies on the significance of the shrinkage coefficient of clays and soils; one of the aims of these investigations being to examine the relationship between the shrinkage coefficient and the clay content of soils.

The author criticises TEMPANY'S hypothesis which explains shrinkage as due to contraction consequent on loss of water by evaporation from the saturated gel-skeleton that ramifies throughout a mass of soil at its point of maximum plasticity. This hypothesis fails to account for the abnormally low shrinkage coefficients exhibited by lateritic soils, notably the red upland soil of Barbados. MASON explained this abnormality by assuming that kneading does not entirely destroy aggregation of soil particles, which is especially well marked in the Barbados red soil. The author showed, however, that

soils of similar colloid content and belonging to one and the same geological type, but showing different degrees of aggregation, possess similar shrinkage coefficients. He therefore sought a different hypothesis to explain soil shrinkage. His own hypothesis is based on the belief that colloidal gels possess a reticulate structure. At the point of saturation, a hydrogel probably contains water in two phases. The first of these is absorbed in the walls of the gel, and represents the moisture content at the hygroscopic coefficient stage. The second phase fills the vesicles of the gel, and is a crystalline phase.

The shrinkage in clays and soils is due solely to loss of vesicular water. Loss of water during the later stages of the shrinkage is accompanied by intrusion of air into the vesicles.

Variations in the shrinkage coefficients of soils of similar colloid content, but belonging to different geological types, are probably due to specificity in soil colloids. This shows itself chiefly in differences in the ratio of absorbed (hygroscopic) water to vesicular water. Red lateritic soils, rich in aluminium hydrogel, appear to possess relatively low vesicular water contents and in consequence, to have low shrinkage coefficients.

The author discusses the physical basis of the assumption that the "water content at the point of maximum plasticity" represents the imbibition capacity of a clay or soil. This constant may be accepted provisionally as marking an important stage in the water relations of clays and soils.

D. v. S.

539. Soil Acidity an Ecological Factor.

KELLY, A. P. *Soil Science*, Vol. XVI, No. 1, pp. 41-54, tables 4, figs. 2, bibliography. New Brunswick, U. S. A., 1923.

The study of soil extracts indicates that a soil of a particular locality has a more or less definite p_H value and that the plants found on that soil usually have a preference for that hydrogen-ion concentration.

The author found that a general average p_H could be assigned to areas of each loam, and that there was correspondance between degree of fertility and p_H value. This p_H value varies at different times of the year, to the extent of p_H 1.0 during the growing season, hence plants growing in these places cannot be seriously affected by small variations in acidity. Acidity was found to increase to a depth of 15 cm. and then to decrease, the increase being greatest in the most sterile soils.

A list of plants growing on certain soils is given. Excessive drying in droughts was accompanied by increased acidity, which was lessened by heavy rains; acidity increased also during freezing. Absorbing roots were found chiefly in the least acid portions of the soil, associated with mycorrhiza in the top 15 cm. of more acid soils, these fungi becoming less abundant as acidity decreased.

Soil acidity, apparently has a different significance for different species, but is an important ecological factor in plant growth.

W. S. G.

540. **The Hydrogen-Ion Concentration of Heavy Alkaline Soils.**

JOSEPH, A. F. and MARTIN, F. J. (Wellcome Tropical Research Laboratories, Khartoum). *The Journal of Agricultural Science*, Vol. XIII, part 3, pp. 321-332, bibl. Cambridge, 1923.

In connection with the systematic examination of the soils of the Sudan, the hydrogen-ion concentration has been determined of a large number of samples taken from a wide area, and with a single exception, all those examined up to the present have been alkaline, the pH value being invariably over 8 and often over 9.

The present article deals with the methods used in this work (the electrometric and the indicator methods; the determination of the pH of soils, the preparation of the soil suspension or extract) and the effect of varying conditions on soil reaction (effect of varying the proportions of soil to water; combined effect of time of extraction and proportion of water; disturbing effect of nitrates; effect of electrolytes; residual effect of electrolytes in the soils; the drying of alkaline soils).

The details of the technique materially affect the results obtained and it is considered essential that they should always be specified in giving numerical results, which otherwise cannot be used for comparison with those obtained by other workers.

D. v. S.

541. **The Fixation of Phosphoric Acid by the Soil.**

FRAPS G. S. *Texas Agricultural Experimental Station Bulletin*, No. 304, pp. 5-22, tables 16. Brazos County, Texas, 1922.

The author studies the relation of fixation to properties of typical Texas soils, especially with reference to the loss of phosphoric acid of fertilisers.

It was shown that fixation of phosphoric acid increased when temperature increased, and when the time of contact with a soil was lengthened. Ignition of the soil raised its power of fixation, even after removal of the lime by acids. Soils having a fixing power of more than 50 %, lost practically no phosphoric acid when treated with acid phosphate and subjected to percolation. Soils with less fixing power than 50 % lost fertiliser phosphoric acid considerably, by percolation. Heavy rains would be necessary to cause loss of phosphoric acid under natural conditions; 3 to 4 inches of rain in 10 days might cause a loss of 3 to 4 % of water-soluble phosphoric acid on a sandy soil with fixing power less than 50 %. An examination of 761 soils and 561 sub-soils showed that increases in the percentages of iron and aluminium oxides gave increase power of fixation of phosphoric acid. A table is given showing the relative fixation of 1413 Texas soils.

W. S. G.

542. **Biochemical Sulphur Oxidation as a Means of Improving Alkali Soils.**

JOFFE, J. S. and McLEAN, H. C. *Science*, Vol. LVIII, No. 1490, pp. 53. Lancaster, Pa., 1923.

A number of suggestions have been made for the improvement of

alkali soils, such as leaching out the soils, or treating with gypsum to convert the carbonates and bicarbonates to sulphates.

LIPMAN has recently suggested a biochemical method by which sulphur is oxidised by micro-organisms and the carbonates converted into sulphates by the sulphuric acid produced in the soil, the soluble salts then being removed by leaching.

The experiments showed that the physical condition of the soil was greatly improved by the treatment and the subsequent rise in bacterial numbers was very marked.

The investigations are summarised by the authors as follows :

- 1) sulphur oxidises rapidly in the early period of incubation ;
- 2) the acid produced coagulates the colloids, destroys the impermeability of the soils and thus allows leaching to take place ;
- 3) indications point to the possibility of making productive, alkali soils of the most hopeless character, by treatment with sulphur followed by leaching.

W. S. G.

Fertilisers and Manures.

543. The Solution of the Problem of Chemical Soil Analysis from the Manual Standpoint.

MITSCHERLICH E. A. Die Pflanzen-Physiologische Lösung der Chemischen Bodenanalyse *Landwirtschaftliche Jahrbücher*, Vol. LVIII, No. 4, pp. 601-617, figs. 6. Berlin, 1923.

This article, which follows two similar articles by the same author (*Landwirtschaftliche Jahrbücher*, Vol. LVI, pp. 71-92, 1921, and *Landwirtschaftliche Jahrbücher*, Vol. LVIII, No. 1 pp. 125-158 1923) (1), deals the problem of the chemical analysis of soils, cultivated plants being used as indicators. The author bases his work on the law of the influence of growth factors (*Wirkungsgesetz der Wachstumsfaktoren*) as previously set out by him. By the application of this law (pot cultures), it is possible to determine with great exactitude the amounts of nutritive substances, assimilable by plants, that are present in the soil.

The author recalls the fact that the effective value of one factor influencing growth is constant. This law is expressed by the logarithmic equation :

$$\log (A-y) = \log (A-a) - C x$$

In this equation A represents the maximum yield obtainable with a certain nutritive substance ; y is the yield obtained by adding the quantity x of this substance ; c is the effective value ; A is the yield obtained without the addition of any nutritive substance to the soil, for by giving x the value of 0 we obtain $y = A$.

This yield A is determined by the amount of the same nutritive substance that was already present in the soil. Assuming the return A to

(1) See No. 547 of this Review. (*Ld.*)

be obtained by the amount of the nutritive substance b , we get the following equation.

$$\log. (A - a) = \log. (A - C. b) \quad (2)$$

Substituting this value in the equation (1) we get:

$$\begin{aligned} \log. (A - y) &= \log. A - c. b - c. x. \\ \text{or: } \log. (A - y) &= \log. A - c (x + b) \quad (3) \end{aligned}$$

The amount b is present in the soil in a form equivalent to the fertiliser x and determines the minimum yield.

The author grew oats in zinc pots lined with paraffin wax. He used for each pot as a basal fertiliser:

4.0	gm.	tribasic calcium phosphate
1.836	gm.	magnesium sulphate
0.5	gm.	sodium chloride
6.6	gm.	sodium nitrate

As a control fertiliser, he chose potassium sulphate. Under these conditions, that is to say, taking into consideration the surface of the pots and the secondary application of sodium, the effective value of the potash was 3.

The pots held 6 kg. of dry soil. The author first used a pure sand ("Grubensand"), and afterwards two calcareous soils (from Fischhausen and Quanditten), mixed with the sand. In the preliminary experiments, these soils did not act upon a potassic fertiliser.

Results of experiments.

TABLE I.

Soil: 6 kg. of sand
yield y as function of potassic fertiliser x .

Potassic fertiliser x	a) Yield grain		b) Yield straw		c) Total yield	
	found	calculated	found	calculated	found	calculated
0.00	5.5 \pm 0.4	5.7	10.9 \pm 0.4	11.3	16.3 \pm 0.7	17.0
0.10	12.3 \pm 0.3	12.2	22.3 \pm 0.3	21.2	34.4 \pm 0.6	33.4
0.25	16.0 \pm 0.3	16.6	27.3 \pm 0.3	27.6	42.4 \pm 0.7	44.1
0.60	18.2 \pm 0.4	18.8	29.6 \pm 0.6	30.7	47.8 \pm 0.8	49.5
1.50	19.4 \pm 0.4	19.0	31.3 \pm 0.1	31.0	50.8 \pm 0.4	50.0

a) $\log (19 - y) = \log 19 - 5 (x + 0.052)$

b) $\log (31 - y) = \log 41 - 3 (x + 0.066)$

c) $\log (50 - y) = \log 50 - 3 (x + 0.060)$

This experiment shows that in this soil (6 kg. of sand) there were 0.06 gm. of potash in an assimilable form for oats (1 mg. K in 100 gm. sand).

TABLE II.

Soil: 5.5 sand 0.5 kg. calcareous soil:
yield y as function of the potassic manure x .

Potassic fertiliser x	a) Yield grain		b) Yield straw		c) Total yield	
	found	calculated	found	calculated	found	calculated
0.00	7.4 \pm 0.6	9.1	13.5 \pm 0.6	15.4	20.8 \pm 1.1	24.5
0.10	14.9 \pm 0.9	15.0	22.5 \pm 1.0	22.7	37.5 \pm 1.6	37.7
0.20	20.7 \pm 0.1	18.9	29.9 \pm 0.8	27.1	50.6 \pm 1.1	49.3
0.60	20.3 \pm 0.7	20.8	29.0 \pm 0.6	29.8	49.3 \pm 1.1	50.6
1.50	20.2 \pm 1.9	21.0	92.1 \pm 2.2	30.0	119.3 \pm 4.1	51.0

$$a) \log (21 - y) = \log 21 - 3 (x + 0.0923).$$

$$b) \log (30 - v) = \log 30 - 3 (x + 0.1045)$$

$$c) \log (51 - v) = \log 51 - 3 (x + 0.0951)$$

If 6 kg. of sand contain 0.06 gm. of potash, 5.5 kg. should contain 0.055 gm. As according to table II, 0.095 gm. were found, the remainder, 0.040 gm., potash, were contained in the 0.5 kg. of added soil. Therefore, 100 gm. of calcareous soil should contain 8 mgm. of potash. The author repeated the experiment with the following mixtures:

Table III; soil, 5.0 kg. sand + 1.0 kg. calcareous soil

Table IV; soil, 4.0 kg. sand + 2.0 kg. calcareous soil.

Theoretically, we should find in the case of table III.

$$\begin{array}{ll} \text{for 5 kg. sand,} & 0.05 \text{ gm. potash} \\ \text{" 1 " calcareous soil} & 0.06 \text{ " potash} \\ \hline \text{Total} & 0.13 \text{ gm.} \end{array}$$

But the actual figures for c given in table III are:

$$\log. (57 - y) = \log. 57 - 3 (x + 0.130).$$

There is a similar discrepancy in table IV:

Calculated amount 0.20 gm. potash
actual amount found for c

$$\log. (55 - y) = \log. 55 - 3 (x + 0.20).$$

The author afterwards gives in 3 other tables, the results of his experiments with another soil (that from Quandtten), which also thoroughly prove his theory.

The same type of experiments made with superphosphate did not, however, give the required results. This is attributed by the author

to the action of the calcareous soil upon the superphosphate which made the effective value of the fertiliser inconstant.

Since the effective value of nitrogenous fertilisers is constant (See : *Landw. Jahrb.*, Vol. LVIII, pp. 125-158), these manures can be used for determining the nitrogen assimilation in different soils according to the method adopted in the above experiments. D. v. S.

544. The Value of Mud.

ARNHOLD, F. (Institute of Agriculture of the University of Leipzig, Germany). Ueber die Bedeutung des Schlicks als Mittel zur Pflanzenernährung und Bodenverbesserung. *Landwirtschaftliche Jahrbücher*, Vol. 58, No. 2, pp. 205-250. Berlin, 1923.

The mud spoken of in this article is a deposit formed at the river mouths of North-West Germany and along the coast, composed of clay, sand, calcareous and humic substances containing débris of organic origin. When freshly laid down, this mud is dark blue and somewhat plastic, later, it becomes more friable and greyish in colour. In the neighbourhood of its deposition, this sediment has long been used for improving poor land. It is especially suited to leguminosae, but has also been employed successfully as a fertiliser in the case of cereals, roots and meadow clovers.

The *mechanical composition* of the mud varies very greatly according to its formation. It has been found to contain 5 to 65 % sand, and 85 to 35 % clay.

Its *mineral composition*, on the other hand, is surprisingly uniform. This mud regularly contains about 7 % calcium, about 0.8 % potash, about 1.8 % magnesia, 0.2 % phosphoric acid and 0.5 % nitrogen.

The sea-mud may be said to be chemically composed for the most part of colloidal silica, clay and humic substances. It contains a remarkable number of algae, especially of diatoms, and as the frustules of the latter, together with shells, make up 5 % of the mud, it is rich in silica and calcium carbonate which promote bacterial development.

The organic remains, as well as the clay, calcium, and silica have a favourable action upon soil dressed with this mud, but the chief manurial value of the mud consists in the *large number of bacteria it contains*. The author found free-living forms of these micro-organisms, such as *Azotobacter*, *Radiobacter* etc., bacteria living in symbiosis with green plants, and sulphur bacteria as well as those forms which decompose organic matter with the formation of ammonia. The nitrifying bacteria, *Nitrosomus* and *Nitrobacter* were especially numerous. The latter is not destroyed by the ammonification bacteria. It is true that loss of nitrogen due to the action of denitrifying bacteria occurs in the recently deposited mud, but after some time, all these bacteria perish with the sole exception of *Bac. fluorescens liquefaciens*.

The good results obtained with this mud are to be attributed to three factors: 1) the improvement of the physical composition of the soil; 2) the increase of nutritive substances; 3) the introduction of very active bacteria. The last factor is of special importance, as it renders super-

fluous the application of any nitrogenous fertiliser. The mud is used for poor land at the rate of 80-100 m³ per hectare, 80 kg. of potash and 100 kg. phosphoric acid being also applied.

Mud suspensions, can be used for inoculating the seed of leguminosae in order to assist the formation of root-nodules.

The author strongly advocates the employment of this mud on a large scale, especially in the case of uncultivated land that has been cleared. The reclamation of such land is at present a question of the greatest importance in Germany. D. v. S.

545. A Comparison of Magnesian and Non-Magnesian Limestone.

LIPMAN, J. G., BLAIR, McLEAN and PRINCE, (New Jersey Agric. Exp. Stations). *Soil Science*, Vol. 15, No. 4, pp. 307-328, bibliography Baltimore, 1923.

In 1908 an experiment was started to test two sources of lime applied in different amounts and in connection with different crop rotations.

The materials used were magnesian (dolomitic) and non-magnesian limestones, each applied at the rate of 1000, 2000 and 4000 pounds per acre, and in the season of 1922, three 5-year periods have been completed.

The author describes every rotation in detail. His general conclusions are the following :

With few exceptions the lime-treated plots have shown substantial increases in crop yield over the check plots. The legumes have shown a greater response than the non-legumes. In most cases the 1-ton application has given some increase over the ½-ton application but this increase is not sufficient to justify the additional expense. The 2-ton application is excessive from the standpoint of economy. There was indication of crop injury from the use of 4000 pounds of magnesian limestone per acre. Aside from this the two forms of limestone gave results that are quite similar with a slight difference in favour of the magnesian limestone.

In the matter of the amount of nitrogen recovered from the crop, the difference between the unlimed and limed plots is more striking than the differences in the case of the crop yields. In this case, also, the magnesian limestone seemed to show a slight advantage. For the legume crops especially, the limed plots showed a higher percentage of nitrogen in the dry-matter than the non-legume crops. This clearly indicates an improvement in the quality of the crop as well as an increase in the quantity. There is evidence that the magnesian limestone favours nitrogen fixation rather more than calcium limestone.

The hydrogen-ion concentration decreased gradually as the lime applications were increased. The results of these experiments show that it is not necessary to fully satisfy the lime requirement of the soil (VERTCH-method) as commonly expressed, in order to get good results with most farm crops.

The nitrogen content of the soil has remained fairly constant during the last 10 years of the period with a slight upward tendency. This

indicates that under the systems of cropping practised in this experiment, the soil is not being depleted of nitrogen and organic matter, nor are the yields decreasing. Undoubtedly the legume crops have been a factor in maintaining the fertility of the soil. In general there is no definite indication that lime has tended to cause an abnormally rapid disappearance of nitrogen and organic matter from the soil. D. v. S.

546. Studies in Crop Variation and Response to Manures.

FISHER, R. A. and MACKENZIE, W. A. (Rothamsted Experimental Station, Harpenden). The manurial response of different potato varieties. *The Journal of Agricultural Science*, Vol. XIII, part 3, pp. 311-320, 2 diagr. Cambridge, 1923.

It is not infrequently assumed that varieties of cultivated plants differ not only in their suitability to different climatic and soil conditions, but in their response to different manures. Since the experimental error of field experiments is often under-estimated, this supposition affords a means of explaining discrepancies between the results of manural experiments conducted with different varieties; in the absence of experimental evidence adequate to prove or disprove the supposed differences between varieties in their response to manures, such explanations cannot be definitely set aside, although one very often suspects that the discrepancies are in reality due to the normal errors in field experiments.

On the other hand, if important differences exist in the manurial response of varieties a great complication is introduced into both variety and manurial tests, and the practical application of the results of past tests becomes attended with considerable hazard. Only if such differences are non-existent, or quite unimportant, can variety tests conducted with a single manurial treatment give conclusive evidence as to the relative value of different varieties, or manurial tests conducted with a single variety give conclusive evidence as to the relative value of different manures.

In a recent experiment at Rothamsted twelve potato varieties were tested with six manurial treatments. The author gives in 5 tables the results of this experiment. The data show clearly, significant variation in yield due to variety, and to manurial treatment. There is no significant variation in response of different varieties to manure. D. v. S.

547. Manurial Experiments in Pots and in the Field.

MRTSCHERLICH, E. A. Der Düngungsversuch (Gefäß- und Freiland-Versuch). *Landwirtschaftliche Jahrbücher*, Vol. LVIII, No. 1, pp. 125-158. Berlin, 1923.

Field experiment. — In the case of a field experiment the test plants are grown on the same soil, as the crop, cultivated later, but this advantage is counterbalanced by a large number of disadvantages.

In the first place, the experimental error is large on account of the physical and chemical differences in the soil. This difficulty can, however, be overcome to some extent by the use of small plots (25m²), by increasing the

number of the plots, and finally by adopting the method of equalising the results which has been described elsewhere by MITSCHERLICH.

Another trouble in field experiments is due to weed-infestation. This can be avoided by using only plants that are practicably free from weeds while the experimental error is diminished if a plant with a high yield per hectare, such as the potato, is employed. By the latter means, the author succeeded in reducing the experimental error to 1 or 2 % of the amounts obtained.

There still remains a third disadvantage in field experiments ; in years of drought, or whenever owing to the influence of other factors, the fertiliser fails to produce any increase in the yield, no conclusions can be drawn from the results obtained.

Pot experiments — In pot cultures, the conditions due to water, temperature and nutritive substances can be improved to the extent of obtaining returns ten times higher than the yield from the open field. Pot experiments are quite independent of meteorological conditions and the soil used can be an average sample of that in which the plants will subsequently be cultivated. There are, notwithstanding, certain disadvantages as the soil used can, at most, be only a layer of 16 cm., as compared with the whole depth of soil found in the field, therefore no data can be obtained regarding the very variable quantities of nutrients substances present in the sub-soil.

Further, it is impossible to use plants like the potato that give a high return, as owing to the large surface area they occupy, the individual error would be too high. For his pot experiments, the author chose oats, since 35 individuals can be grown in one pot and the results can be expressed in quintals per hectare, like those obtained from field experiments with potatoes.

The differences in yield are, however, really larger in the case of pot cultures, hence the great importance of the latter in manurial experiments.

The author has already shown elsewhere (*Landwirtsch. Jahrbücher*, Vol. LVI, pp. 71-92) that the effective value of a factor influencing growth is constant, quite independently of other factors. The relation of the pot experiment and of the field experiment is theoretically determined. The effective value (*Wirkungswert*) of a fertiliser is always the same ; that is to say, the increase of the crop in percentage of the maximum yield remains unvaried for the same quantities of fertiliser, whatever this maximum yield may be, or whatever other factors may come into play. Therefore, the fact that the conditions of water, temperature light etc., are good is of no importance.

It is, however, absolutely necessary for the effective value (*Wirkungswert*) to be expressed in relation to the same surface unit. This can be done by means of the equation :

$$\log (A - y) = \log. A - c x$$

The effective value c , is thus entirely independent of the maximum yield A , and of the yield y , but it is not independent of the amount of fertiliser applied, x .

The author made over 1000 pot experiments and as many field experiments in the course of this work (6 parallel experiments in pots and 4 in the field). The results obtained are given in 60 tables. He quotes the following as the axiom:

The effective value of sulphate of ammonium is 0.025 expressed in quintals per hectare. — This statement is proved by means of the above equation expressing y (the increased yield) in percentage of the maximum yield (A here = 100). The value x represents the amount of sulphate of ammonia applied, expressed in quintals per hectare $\log(100 = y) = 2 - 0.023 x$.

TABLE I.

Fertiliser x quintals per hectare	Yield y in %	Fertiliser x quintals per hectare	Yield y in %	Fertiliser x quintals per hectare	Yield y in %	Fertiliser x quintals per hectare	Yield y in %
0.0	0.0	7.0	33.2	14.0	55.3	27.0	78.9
0.5	2.8	7.5	35.1	14.5	56.6	28.0	80.1
1.0	5.6	8.0	36.9	15.0	57.8	29.0	81.2
1.5	8.3	8.5	38.7	16.0	60.2	30.0	82.2
2.0	10.9	9.0	40.4	17.0	62.4	32.0	84.1
2.5	13.4	9.0	42.1	18.0	64.5	34.0	85.9
3.0	15.9	10.0	43.8	19.0	66.5	36.0	87.4
3.5	18.3	10.5	45.4	20.0	68.4	38.0	88.6
4.0	20.6	11.0	46.9	21.0	70.2	40.0	90.0
4.5	22.8	11.5	48.4	22.0	71.8	45.0	92.5
5.0	25.0	12.0	49.9	23.0	73.4	50.0	94.4
5.5	27.1	12.5	51.3	24.0	74.9	60.0	96.8
6.0	29.2	13.0	52.7	25.0	76.3	75.0	98.7
6.5	31.2	13.5	54.0	26.0	77.6	100.0	99.7

Assuming that 20 quintals of sulphate of ammonia per hectare were found in the soil used for the pot experiments, the unfertilised pot would give 10.9 % of the maximum yield (see table). With 18.0 quintals of sulphate of ammonia per hectare, we should obtain 64.5 % of the maximum yield, or 492 % more than the yield of the unfertilised pot.

In the field, the layer upon which the plants can draw is twice as deep so that without a fertiliser we get 10 quintals of nitrogen per hectare and a return of 43.8 % of the maximum yield. By increasing the rate to 18.0 quintals per hectare in an attempt to get 64.5 % of the maximum yield, the increased yield would only be 20.7 % of the maximum yield, or 47 % of the yield already produced without any application of fertiliser.

The increase in the yield is thus about 10 times greater than in the case of the field experiments. This is what confers a great advantage upon the pot experiments which are able to register slight differences. A fertiliser producing no increase in yield in pot cultures would certainly fail to augment the crop in the field.

In the tables recording the results, the author always gives the value of y calculated according to the logarithmic equation alongside of the found

value of y . The agreement between the figures is so striking, that 0.025 can be accepted without reserve as being the value for sulphate of ammonia.

In a similar manner, the author determines the factor for nitrate of soda; the effective value of this fertiliser can be expressed by 0.02.

The experiments made for the purpose of determining the potash factor proved less interesting, because the soils used reacted but little on potash. The relation existing between the pot and the field experiments was, however, brought out very clearly.

The phosphoric acid experiments will be published separately.

The author also gives a comparative table.

TABLE II. — *Effect of 100 kg. of fertiliser per hectare of surface on the yield expressed in % of maximum yield.*

a = sulphate of ammonia

b = superphosphate

c = 40 % potash salts

Quintals per hectare	a	b	c	Quintals per hectare	a	b	c	Quintals per hectare	a	b	c
0.0	0.0	0.0	0.0	8.0	36.2	77.1	91.4	17	62.4	95.6	99.5
0.5	2.8	8.8	14.2	8.5	38.7	79.1	92.6	18	64.5	96.4	99.6
1.0	5.6	16.8	26.4	9.0	40.4	80.9	93.7	19	66.5	97.0	99.7
1.5	8.3	24.1	36.9	9.5	42.1	82.6	94.6	20	68.4	97.5	99.8
2.0	10.9	30.8	45.9	10.0	43.8	84.1	95.4	21	70.2	97.9	99.8
2.5	13.4	36.9	53.6	10.5	45.4	85.5	96.0	22	71.8	98.3	99.9
3.0	15.9	42.5	60.2	11.0	46.9	86.8	96.6	23	73.4	98.5	99.9
3.5	18.3	47.5	65.8	11.5	48.4	88.0	97.1	24	74.9	98.7	99.9
4.0	20.6	52.1	70.7	12.0	49.9	89.0	97.5	25	76.3	98.9	100.0
4.5	22.8	56.2	74.9	12.5	51.3	90.0	97.8	26	77.6	99.1	100.0
5.0	25.0	60.2	78.5	13.0	52.7	90.9	98.1	28	80.1	99.4	100.0
5.5	27.1	63.7	81.5	13.5	54.0	91.7	98.4	30	82.2	99.6	100.0
6.0	29.2	66.9	84.1	14.0	55.3	92.4	98.6	35	86.7	99.8	100.0
6.5	31.2	69.8	86.4	14.5	56.6	93.1	98.8	40	90.0	99.9	100.0
7.0	33.2	72.5	88.3	15.0	57.8	93.7	99.0	45	92.5	99.9	100.0
7.5	35.1	74.9	90.0	16.0	60.2	94.8	99.3	50	94.4	100.0	100.0

Before the war, the following was considered a liberal dressing :

3 quintals per hectare	sulphate of ammonia	(a)
5 " "	superphosphate	(b)
4 " "	40 % potash salts	(c)

If the soils were dressed with 5 quintals per hectare of these fertilisers, or their equivalents, the yields would be increased as follows :

Ammoniacal fertiliser : increase 25.0 to 36.2 % of the maximum return obtainable with ammonium ; phosphatic fertiliser from 60.2 to 84.1 % increase ; potash fertiliser : 78.5 to 93.7 % increase.

Thus, only one-third of the maximum yield produced by nitrogen can

be obtained, whereas with phosphoric acid, and especially with potash, the maximum yield is almost reached.

Assuming that the soil already contains 10 quintals per hectare of each of these fertilisers, this result is still more pronounced.

Increase 'due to nitrogen from	43 8 to 52 7 %
" " " pho-phoric acid, from	85 5 " 93 7 %
" " " potash, from.	95.4 " 98.6 %

It is, therefore, not surprising that most soils are very susceptible to a nitrogenous fertiliser, but it would be a great mistake to give up *a priori* the use of phosphoric acid and potash as fertilisers, for only small quantities of these substances may very considerably increase the crop (see table II). Superphosphate applied at the rate of 5 quintals per hectare may sometimes double the return. A heavy dressing with a nitrogenous fertiliser is to be recommended generally, where the upper layer of the soil contains less than 5 quintals per hectare of sulphate of ammonia. If there are already 20 quintals per hectare present in the soil, a nitrogenous fertiliser will have no further effect.

The author's work has thus shown the importance of pot experiments for the determination of the manurial requirements of different soils.

D. v. S.

548. Results of Experiments in Field-Manuring, made during 1918-19 in the Territory of the "Vorstenlandsche Tabakscultuur" (Java).

BEETS, A. N. J. Bemestings proeven 1918-19 *Proefstation voor Vorstenlandsche Tabak* ~ Meedeeling, No. 46, pp 1-66. Buitenzorg, 1923.

During 1918-19 the following manures were tried on the experiment fields: 1) Lime; 2) Dessa-earth; 3) Stable-manure; 4) Sulphate of ammonia; 5) Nitrate of soda, Phosphate-manure; 6) Bat-dung; 7) Earth-nut-cake; 8) Tobacco-seed cake. The field-experiment on the Djoewiring Estate showed clearly that on the heavy soil on which the test was made, where tobacco had never been planted, the manuring with lime had a favourable influence both on the yield per acre and on the length, quality and colour of the leaves.

Manuring with dessa-earth and stable-manure gave the same good results as in past years (see Publications 32 and 41). These manures deserve the fullest attention on different sorts of soil by reason of: 1) the yield per acre; 2) the length of the leaves; 3) the quality of the product, but they can, under certain circumstances, lead to infection of the soil with *Phytophthora Nicotianae*, the cause of the well-known "lanas" disease.

The effect of manuring the plants with sulphate of ammonia was nearly everywhere well shown by measuring the length of the leaves. The conditions were not favourable in this year. The plants on the different test-gardens were nearly full grown when it began raining, in consequence of which the leaves from the lower part of the plants could not benefit from the manure. By measuring the length of the leaves from

the middle and upper-part of the plants, the advantage from the manure was shown in nearly every instance.

Nitrate of soda, a very hygroscopic salt, gave a less good result than sulphate of ammonia, notwithstanding the fact that the same quantity of nitrogen was given to the plants.

Phosphates gave no certain result, owing to the miscarriage of many test-fields, caused by diseases among the young plants.

Bat-dung (collected in caves as a product of the excrements of bats) gave nowhere good results.

Earthnut cake (katjang-boengkil), a by-product of the manufacture of oil from seeds of *Arachis hypogea*, had a very good effect on the growth of the plants on a grey heavy soil, which was shown by the yield per plant and by measuring the length of the leaves.

Tobacco-seed cake (tabakszaad boengkil) gave good results but it will not be possible to get enough of this manure for manurial purposes on a whole estate, as it is necessary to give a large amount per plant (7 % nitrogen). In some of the field tests it was shown that it is necessary to mix the seed cake manures very well with the soil before planting. If this is not done, many of the plants die shortly after planting.

D. v. S.

549. The Maintenance of Organic Matter in Soils.

SIEVIERS, F. J. (Washington Agricultural Experiment Station). *Science*, vol. LVIII, No 1492, pp. 78-79 Lancaster, Pa, 1923

Investigations have shown that the ratio between the nitrogen and the organic matter, and also between the carbon and the organic matters of soils, is practically a constant, e. g. —

$$\begin{aligned} \text{Organic matter} &= \text{Carbon} \times 1.724 \\ \text{or Organic matter} &= \text{Carbon dioxide} \times 0.471 \\ \text{or Organic matter} &= \text{Nitrogen} \times 20 \\ \text{then } \frac{\text{Carbon}}{\text{Nitrogen}} &= \frac{20}{1.724} \end{aligned}$$

or Nitrogen : Carbon :: 1 : 11.6.

When organic matter composed of low nitrogen carrying material, is applied to a soil, nitrate accumulation is hindered, and this effect continues until decomposition liberates sufficient carbon, in the form of CC_2 , to restore the nitrogen carbon ratio to about 1 : 12. Under natural conditions this ratio is maintained, but in the case of intensive cultivation the carbon is lost more rapidly, than the nitrogen, and the ratio is always slightly narrower in cropped than in virgin soil.

Manure contains only about 10 lb. of nitrogen to the ton, and straw contains a similar amount, hence this quantity of nitrogen can fix only about 120 lb. carbon, or a total of 200 lb. of organic matter, which when decomposed would not supply the requirements of one crop.

To maintain soil organic matter the nitrogen supply must be maintained, in which case sufficient carbon will be fixed. This can be done

through the growth of legumes and the use of fertilisers. The ill effects of legumes or straw used singly can be avoided by adding the straw as a surface dressing on the legume soil before it is broken up by the plough.

W. S. G.

550. Phosphate Reserves of Russia.

PRJANISCHNIKOW. Phosphoritlager im Russland in Lichte der neueren Forschungen. *Zeitschrift für Pflanzenernährung und Düngung*, Vol. II, No. 6, pp. 315-321. Leipzig-Berlin, 1923.

The phosphate question occupies as prominent a position in the fertiliser problem in Russia as it does in Germany in spite of the different development of the rural economy of the two countries.

Germany, notwithstanding her intensive cultivation, has been able by means of her chemical industry to obtain all the potash and nitrogen she needs, but since she possesses few, or no, deposits of natural phosphorite, she has great difficulty in satisfying her phosphate requirements.

Russia, on the other hand, has hitherto been a country of extensive cultivation, and consequently of low yields. In exporting countries where wheat is cheap, the crop returns are always less than in importing countries. The fertilisers commonly applied in Western Europe could not be used in Russia on account of their prohibitive price; in the wheat-growing provinces, nitrate, for instance, costs $3\frac{1}{2}$ to 4 times as much as barley. The high price of fertilisers, and not the Russian peasants' lack of technical knowledge, has prevented their application to the land. Further, the soils of Southern Russia (Black Soils), are so rich in nitrogen, that leaving the fields fallow produces an accumulation of nitrates. The soils of Northern Russia need fertilisers, but the sole manure generally available is dung, or clover; only in the case of sugar beets, or kitchen-garden crops, could nitrate be afforded. The same may be said of potassic fertilisers, although Russia possesses a supply of potash in the form of ashes (annual production 1.5 million tons).

The question of phosphates is quite different, nearly all the Russian soils including the black soils, react to a phosphatic fertiliser, and even before the war, more or less phosphates were applied.

Now, however, the conditions have entirely changed, for as super-production has ceased in the South, the northern areas are forced to produce their own wheat, and since dung is lacking, the only course is to use mineral fertilisers, and especially phosphates. Russia possesses extensive deposits of phosphorite that could be worked, and even exported, if means of transport were established. The whole question has been studied lately and the findings of the Commission appointed to investigate these deposits have been published in two series by the Moscow Academy of Agriculture (PETROWOKO-RASUMOWSKÉ) under the titles of, I. Geological Researches on Russian Phosphorites; II. The Chemical Treatment of Russian Phosphorites and Researches on their Application (published in 1919 and 1921).

The preliminary investigations have shown the existence of 5568 million tons of phosphorite which is, however, of very varying quality.

Type 1	(containing over 24 % $P_2 O_5$)	141 million tons
" 2	(" 18 — 24 % $P_2 O_5$)	1707 " "
" 3	(" 12 — 18 % $P_2 O_5$)	3730 " "
		<hr/> 5568

Considerable deposits of phosphorites belonging to the first type are believed to be present, although they have not yet been surveyed. The author gives a description of the phosphorite deposits basing his observations on the data supplied by Prof. SAMONOW. The most important are those on the banks of the Kama, in the Government of Wjatka. Similar phosphorites much resembling the phosphates of South Carolina are to be found on the banks of the Volga near the town of Kineschma (present output about 3000 tons per annum).

The author also describes the deposits in the Governments of: Moscow and Kaluga (21 to 24 % $P_2 O_5$); Simbirsk, Penda and Tambow (20 to 21 %); Tschernigow (23 %). A single continuous deposit extends across the Governments of Smolensk, Kaluga, Orel, Kurrsk and Woronesch (15 % $P_2 O_5$). Similar phosphorites are also to be found on the peninsula of Mangyschlak. In the Urals, phosphorite deposits with 32 to 36 % $P_2 O_5$ have been discovered, while in Bessarabia, there are beds with 32 to 35 % $P_2 O_5$, but their extent has not yet been ascertained.

The large Ural reserves could well be used for making superphosphate and the phosphorite found on the banks of the Kama might be transported as far as the Volga, if the bed of the Kama was deepened for a distance of some 200 km., and may therefore be reckoned among the phosphates that can be exported to Germany.

The phosphorites with a low percentage of $P_2 O_5$ can be used in two ways:

- 1) Transformed into a 40 % double superphosphate, or precipitated phosphate;

- 2) Applied in a pulverised form without any chemical treatment.

The author has studied the extraction of these phosphorites by treatment with sulphuric acid in the laboratory, and is of opinion that the precipitated phosphate process is likely to be the one most adopted in future.

Pulverised phosphorite is to be recommended in the case of certain plants 1) and soils 2) and for use in conjunction with some other fertilisers 3).

- 1) Application of phosphorite to lupins to be used as green manure (see articles of the same author in 1896-7).

- 2) Certain acid soils but also some soils that are not saturated with bases, have the power of decomposing phosphorites. This type of soil is very common around the black soils. Prof. KNIERIM (Riga) states that phosphorites mixed with peat (1:100) form a good fertiliser with $\frac{2}{3}$ of the phosphoric acid in a soluble condition.

- 3) Sulphate of ammonium mixed with phosphorite increases the solubility of the latter (see articles of the same author, 1900)

The author is of opinion that the phosphorite deposits of Russia will soon become of considerable importance.

D. v. S.

551. The Constitution and Manurial Value of Low Grade Basic Slag.

MCARTHUR, D. N. *Journal of the Society of Chemical Industry*, Vol XLII, No 20, pp 213-216, bibliography, London 1923.

The basic process for the manufacture of steel has recently undergone many changes, and the basic open-hearth fluor-spar slags are not comparable in fertilising value with the Bessemer slags, and the citric-solubility test is merely empirical in estimating their value.

The author made a great number of chemical and microscopical examinations of open-hearth slags, and carried out pot and field trials to ascertain the relation between their constitution and the manurial value.

The conclusions drawn from the experiments were that, open-hearth fluor-spar slags of low phosphate content have a distinct fertilising value and could be used to replace ground limestone in agricultural practice. The experiments showed clearly the importance of fineness of grinding on the availability of slags.

W. S G

552. The Nitrogen Problem in Great Britain.

KILBURN SCOTT, E Nitrogen Fixation by the A1c process *The Chemical Trade Journal and Chemical Engineer*, Vol LXXII, No 1875, pp 451-453 London, 1923 — IDEM, Progress in Nitrogen Fixation *Ibidem*, Vol LXXII, No 1874, p 488 London, 1923 — IDEM The Muscle Sheals Nitrogen-fixation plant *Ibidem* Vol LXXII, No 1875, pp 513-514 London, 1923 IDEM Nitrogen, Fixation problems *Ibidem*, Vol LXXII, No 1875, pp 515-516, London, 1923 — *Ibidem*, Nitrates from the air *Chemistry and Industry*, Vol 42, No 20, pp 498-499 London, 1923

During April 1923 Mr KILBURN SCOTT gave a series of three Cantor Lectures at the Royal Society of Arts (London) on the fixation of nitrogen from the air. He appears to be an enthusiastic advocate of the development in Great Britain of direct electrical processes for the manufacture of nitrates and he has himself invented a nitrogen furnace using three phase current.

In the first of his lectures he mentioned the reasons which led the Ministry of Munitions to install a small cyanamide factory at Dagenham Dock and ultimately to erect a large factory for the manufacture of ammonia by the Haber process at Billingham-en-Tees. One method which would have produced nitric acid with absolute certainty with the least possible amount of labour and no cost for raw materials, is the arc process, but this was deliberately shelved by the men at the head of affairs.

Coming to the technical part of the subject he, divided the methods of making nitrates from the air electrically into two parts, the direct and the indirect methods, the first being a single process and mainly electrical, the second consisting of several processes partly chemical and partly electrical. The several types of nitrogen fixation arc furnaces are divided into groups according to the methods of forming the arc flames:

1) Those which have a mechanically moving part—viz, the Bradley and Lovejoy (Niagara Falls) and the Island (Toronto).

2) Those which have a magnetic field to direct the arcs—viz., the Birkeland-Fyde (Norway and France) and the Moscicki (Switzerland),

3) Those which have a rodlike standing arc—viz., the Schonherr (Norway) and the Wiegolofsky (Seattle, U. S. A.).

4) Those which depend upon air currents to direct the arc—viz., Pauling (Innsbruck) and the Hocklenbleckner (Nitroles S X., U. S. A.). All the above require single phase alternating current, and have to be used in sets of three, on the three phase circuit.

5) The Kilburn Scott furnace, which has air-blow arc flames and pilot arcs to keep them steady (Birmingham and New Jersey, U. S. A.).

6) The Nitrum furnace (Bodio, Switzerland, and Rhina, Germany). This has a disc-like arc revolved horizontally by three air currents. Systems 5 and 6 use three phase current in one reaction chamber.

The usual production from a single phase type of furnace, employed in Norway, amounts to 62 gm. of nitric acid per kw.-hr., whilst tests on the three phase type of furnace have given between 90 and 100 gm. of nitric acid per kw. hr. The commercial importance of the arc process is illustrated by figures of the output of the Norsk Hydro-Elektrisk Kvaelfestfaksieselskab which supplied during 1919, 67 419 tons of nitrate of lime and exported about 50 000 tons of nitric acid, sodium nitrite, sodium nitrate and ammonium nitrate.

A description is given of the plant at Pierrefitte (Pvrenées) which uses also Birkeland Fyde furnaces and where nitric acid can be manufactured at a cost of £6 per ton, power costing 20 s. per kw.-year.

As illustrating the three-phase system the furnaces used by the Nitrum Co. of Zurich (Switzerland) are taken. The yield of nitric acid is from 75 to 80 gm. per kw.-hr. The Nitrum process has given good results in a 6000 kw. plant at Bodio, Switzerland, for over 10 years and at Rhina, near Laufenburg for 7 years.

In an arc process plant the percentage of capital cost of the acid and alkali absorption towers is nearly half the total cost, and the problem to be solved is to cut down this great capital expenditure. It can be reduced by increasing the percentage of nitric acid, as in the Nitrum furnace, which results in a reduction of the tower size.

Another method would be to pass the gases through the towers under pressure as adopted in the latest type of Häusser plant. The improvements in the Häusser plant (Westphalia) consist in increasing the capacities of the bombs used.

A description is given of the American Mussel Shoals plant, which was only tested and had been standing ever since. It was intended to produce 40 000 tons of fixed nitrogen per annum. In this plant nitrogen is fixed as cyanamide; ammonia is produced from cyanamide and ammonia converted into nitrogen oxides.

In his third and last lecture Mr. SCOTT describes the Haber and the Claude processes, both synthetic ammonia processes. It would seem that the huge scale upon which Germany is exploiting the Haber process has consciously or unconsciously influenced the minds of the vast majority of technologists in England and France into the belief that the Haber process

is the one to be adopted wherever possible, and that the arc process is only to be considered seriously in very exceptional cases. *The Water Power Resources Committee* of the Board of trade, who investigated the subject in 1922, estimated that the potential resources of water power in Great Britain are capable of producing some 250 000 H. P. of which 160 000 are available in Scotland.

The lecturer pointed out that New Zealand wanted fertilisers and that in that country there are many waterfalls, so that it is an ideal country for the making of fertilisers by the arc process. In India there are waterfalls, and also coal mines and the arc process could be used near the former and the Häusser process near the latter. He agreed that it was economically unsound to utilise ammonia for making nitric acid when the latter could be obtained in other ways. Finally he pleaded for a *Nitrogen Research Department*.
D. v. S.

553. The Efficient Recovery of Nitrates from Caliche.

TURRENTINE, J. W. (Bureau of Soils, U. S. Department of Agriculture). *Industrial and Engineering Chemistry*, Vol. 15, No. 8, pp 853-855. Washington, 1923.

The many reports appearing in the current press relative to the present situation in the nitrate industry of Chile all give substance to the impression that conditions there are far from ideal. The situation is confused with various elements, such as local politics, finance and international commerce, but evidence remains that the trouble is fundamentally one of poor chemical engineering. The nitrate industry is experiencing the results of the total loss of an important part of its market, Germany, now on an entirely self-supporting basis. It is faced with the loss of other markets through a similar development of the air nitrate industry in the various countries, notably the United States. It is evident that the perpetuation of the Chilean industry is not essential to America, but it is not certain that its destruction will not prove a great loss to the world in general.

The cost of producing and selling Chile nitrate has been apportioned as follows:

Export tax	41
Bags	6
Transportation	11
Overhead Tax	3
Labor	19
Fuel	11
Interest	9

Great improvement in the situation could be made in three directions: The Government might surrender its export tax, thus reducing the price in the market by that substantial amount. Plants and processes could be improved so as to reduce the manufacturing costs. If capital is not readily available, it could be furnished by the Government with the enforced amalgamation of small properties into larger groups, thus greatly reducing

the cost of rehabilitation. (The prosperity of the Chilean government is so intimately linked with that of the industry that the two cannot be separated). With new processes the yield from by products, now imperfectly exploited could be increased. Propagandizing activities in foreign countries could be enlarged.

D. v. S.

554. The Application of Nitrogenous Fertilisers to Grassland.

HOFFMANN, R. Stickstoff-Düngungsversuche auf Grünland. *Landwirtschaftliche Jahrbücher*, Vol. LVIII, No. 4, pp. 567-600. Berlin, 1923.

As a result of his experiments, WAGNER concluded that a nitrogenous fertiliser was not to be recommended for meadows. (WAGNER: "Versuche über Wiesendüngung", *Arbeiten der D. L. G.*, No 162, and also "Die Düngung der Wiesen" *Arbeiten der D. L. G.* No. 308). Other investigators, such as WARNBOLDT (*Jahrbuch der D. L. G.*, 1918), and NEUBAUER (*Mitteilungen der D. L. G.*, No. 50, No. 108, 1921) do not agree with his dictum, and strongly advocate the application of nitrogenous fertilisers to grass-land.

This divergence of opinions is probably due to differences in the soils used in their experiments by the several workers.

The author based his research upon the experimental methods practised by MITSCHERLICH; these allow results to be interpreted in a strictly mathematical and wholly objective manner. His conclusions may be summarised as follows:

The hay yields (in quintals per hectare), may be expressed, in logarithmic function of the amount of sulphate (quintals per hectare) applied, by the following equation: $\log. (A - y) = \log. A - 0.025 (x + z)$.

In this equation, A represents the maximum yield, y the quintals of hay per hectare, and x the quintals of sulphate of ammonia per hectare. By means of this formula, it is possible to calculate in advance the hay yield obtainable with any given amount of sulphate of ammonia (provided A be known).

The effective value of the ammonium sulphate expressed in the formula by the factor $c = 0.025$ proved constant in all the experiments, that is to say, it is independent of all the factors affecting A . Therefore, a determined value in relation to the other nitrogenous fertilisers may be given to ammonium sulphate. This value is 0.025 and is independent of climate, soil, the species of plant cultivated, etc.

In the equation, the value z expresses, in quintals per hectare, the amount of nitrogen equivalent to the sulphate of ammonia contained in the soil. The author made experiments with 3 types of grass-land:

I Meadows of timothy-grass (<i>Phleum pratense</i>)	3 =	}	14.86
			12.84
II Permanent pastures	3 =	}	4.45
			4.19
			3.00
III Meadow-moors (Moor-Wiesen)	3 =		9.00

The great effect made upon grassland with a mineral sub-soil is thus easily explained. A potassic phosphatic fertiliser has generally no effect; only in one case did the author record a higher yield due to its application.

The nitrogenous fertiliser considerably increased the growth of grass, even in plots I, but the clover entirely disappeared. In plots II, there was an increase in the number of dandelions (*Taraxacum officinale*) and of yarrow (*Achillea millefolium*), especially in the second cutting. The latter only gave a better return when at least 8 quintals of sulphate of ammonia were applied per hectare.

The author detected a slight toxic action upon the plants when the field had been dressed with 8 quintals of ammonium sulphate + 2 quintals of 40 % potash salts + 3 quintals superphosphate per hectare.

The differences due to soil variation can be reduced by one half if the MITSCHERLICH method of calculation is adopted. D. v S

555. Efficiency of Ammonium Sulphate on Alkaline Soil.

PRESCOTT, J. A (Sultan's Agricultural Society, Cairo, Egypt). The efficiency of ammonium sulphate as a fertiliser. *The Journal of Agricultural Science*, Vol XIII, No 3, pp 331-339, 1 fig Cambridge, 1923

Field experiments with maize at the Bahtim Experimental Station and laboratory tests indicate that the lower efficiency of ammonium sulphate as compared with nitrate of soda is due, principally under these special conditions, to the liberation of ammonia from the fertiliser in contact with an alkaline soil. The rate of this liberation is a function of the aeration and of the soil reaction. D. v S

Agricultural Botany.

556. Electrically-Induced Changes in Plants.

I. — RACIONIERI, A, and MEUNISSIER, A. L'électro génétique *Revue Horticole*, Year 95, No 16, p 334 Paris, 1923.

II. — PIROVANO, A, Sur la Discipline de l'hérédité chez les végétaux, l'électrogénétique. *Ibidem*, No 21, pp 459-463, figs. 9.

I and II. — It is to PIROVANO we owe the ingenious idea of producing changes in different species of plants by the modification of the genital plasma previous to fertilisation, for which purpose he used electricity (1). This electricity is derived from various sources: electromagnetism, x-rays, ultra-violet rays, and radio-active emanations. PIROVANO worked upon pollen (male reproductive plasma), as being easily handled, and obtained most remarkable results. The pumpkin (*Cucurbita Pepo* var. *cucurbitella*), which is habitually a dioecious plant, was rendered monoecious, and even hermaphrodite; the wild *Althaea rosea* underwent changes in habit, and also in the size, colour shape and arrangement of the flowers, so that

(1) See ALBERTO PIROVANO, *La mutazione elettrica delle specie botaniche e la disciplina dell'eredità nell'ibridazione*. Milan, Hoepli, 1923.

they assumed the appearance of the flowers belonging to *Hibiscus Syriacus*. In other species, gigantism, dwarfness, a tendency to run to seed, changes in the shape of the fruits etc. were produced. These changes have proved to be transmissible.

PIROVANO has applied the term ionolozation ("ionolizzazione") to this process of altering pollen by means of electricity which disturbs the molecules of the genital plasm so as to prevent its reproducing the species in the natural way, although the fertilising property of the pollen is not impaired.

When ionolization is produced by alternate currents, results of considerable importance are only obtained with short exposures to high frequency currents (500 or 600 periods), but even with the ordinary electric-light plant used for an electro-magnet, it is possible to carry out the simple experiments described and explained by the author. Any horticulturist can thus obtain varied and strange forms.

F. D.

557 Iron and Manganese Content of certain Species of Seeds.

MCHARGUE, J. S. *Journal of Agricultural Research*, Vol. XXIII, No. 6, pp. 395-399 Washington, D. C., 1923.

In recognition of the fact that manganese is a necessary nutrient in plant growth, the author made a series of determinations as to the amount of iron and manganese contained in seeds of certain species of plants and has correlated the results obtained. The species tested included: wheat, oats, peas, beans, soy beans, clovers, grasses, sunflower, hemp, flax, rape, tobacco.

Results indicate that the average manganese content of seeds of wheat and oats produced under normal conditions in the soil is equal to the average iron content. The oatmeal prepared for human consumption affords one of the richest sources of manganese in food.

In the seeds of leguminous plants, the proportion of manganese is invariably less than the iron content. For garden peas and beans the average rate is 1:6; for soy beans 1:3; for clover 1:4; for *Agrostis* spp. 1:3. The manganese content of wheat and oats is approximately three times that contained in peas and beans.

The amount of iron and manganese found in grasses showed considerable fluctuations with varieties, but the average results are nearly equal. White and yellow maize contained the smallest amount of both. Hemp on the contrary showed a comparatively high percentage.

M. I. Y.

558. Effect of Manganese on Plant Growth.

I. MCHARGUE, J. S. (Department of Chemistry, Kentucky Agricultural Experiment Station). The Role of Manganese in Plants. *The Journal of the American Chemical Society*, Vol. 44, No. 7, pp. 1592-1598, figs. 2, Easton Pa., 1922.

II. IDEM. Effect of Manganese on Plant Growth, *Journal of Agricultural Research*, Vol. XXIV, No. 9, pp. 781-794, tables 6, bibliography. Washington, D C, 1923.

Reference is made to foregoing investigations on this subject (1). The purpose of the author in continuing these studies was two-fold:— To determine definitely if manganese is an essential element in plant economy, and to show the effect of increased concentrations of manganese sulphate on plant growth.

Earlier experiments have shown that the seed coat contains a greater concentration of manganese than any other part of the seed, and working on this basis the author carried out tests to ascertain the ultimate effect on plant growth if seeds are germinated and the plants grown to maturity in a medium which contained all the known plant nutrients with the exception of manganese compounds. Results indicate that in a *limited* degree, manganese is evidently essential for normal growth and development of plants. The first effect to be noted is the lack of formation of chlorophyll and the obvious function of manganese in the photosynthetic process. The subsequent etiolated condition of the leaves and buds bears out this point. Apparently leguminous plants are dependent on this factor more than non-legumes. Seeds of plants tested (radish, soy bean, cowpea, field pea) maintained normal development only for the first 4-6 weeks of growth, suggesting that manganese is concerned in nitrogen assimilation and syntheses of protein.

As regards the possible deleterious effect of *excess* of manganese on growth, experiments were made at the Kentucky Agricultural Experiment Station with plants grown in acid and neutralised portions of the same soil to which were added definite amounts of manganese sulphate. Results demonstrated that an excess of manganese sulphate in acid soils has a detrimental effect on plant growth. Applications have caused a distinct decrease in crop yield. The addition of calcium carbonate has, however, a neutralising effect and has resulted in a subsequent increase in yield of similar crops.

It should be noted that manganese is intimately associated with iron, phosphorus and calcium compounds, and bearing in mind the fact that only very small amounts of this element are required for plant nutriment, it is probable that contamination of the nutrients with manganese has hitherto been an unrecognised source of error in determining the requirements of plant economy.

Further investigations are in progress, with a view to ascertaining the relation of manganese to other important phases of plant and animal life.

M. L. Y.

(1) Special attention should be drawn to the comprehensive work of Dr. W. BRENCHLEY (Rothamsted Experimental Station) "Inorganic Plant Poisons and Stimulants", Cambridge, 1914. (Ed)

559. The Effect of Respiration upon the Protein Percentage of Wheat, Oats and Barley.

Mc GINNIS, F. W. (Professor of Farm Crops, Division of Agronomy and Farm Management), and TAYLOR, G. S. (Division of Chemistry Department of of Agriculture University of Minnesota) *Journal of Agricultural Research*, vol. XXIV, No. 12, pp. 1041-1048, tables 2, bibliography. Washington, D. C. 1923.

Investigations made at the Minnesota Agricultural Experiment Station based on the variation in protein percentage found in the different grains when produced under different conditions of soil and climate. Marquis wheat, improved Ligowa Oats and Manchuria barley were grown in 17 localities in the United States and respiration studies were made with the seeds each year.

The loss of carbohydrate material during the ripening process is apparently considerable. The greater percentage of loss incurred before the process of desiccation begins, while the grain contains above 40 % moisture. The protein content is influenced to a marked degree by the loss of carbohydrate during the ripening period. Environmental conditions have a marked influence on the synthetic process, and respiration plays a comparatively unimportant part. Wheat showed more variation in the protein percentage than barley or oats, and barley was apparently more variable than oats.

M. I. Y.

560. Relation between the Amount of Nutritive Substances in the Soil and their Assimilation by Plants.

KÖNIG, HASENBAUMER and SCHAFERS. Beziehungen zwischen dem Nährstoffgehalt des Bodens und die Kartoffeln.

IDEM Beziehungen zwischen dem Nährstoffgehalt des Bodens und der Nährstoffaufnahme durch den Hafer nebst einem Beitrag über den Einfluss von Pflanzen und Düngern auf die Bodensäure. *Landwirtschaftliche Jahrbücher*, Vol. LVIII, No. 1 pp. 55-124. Berlin, 1923.

Experiments with potatoes. — These experiments had for their object the determination of the relation between the quantity of easily soluble nutritive substances present in the soil and the amount of these substances actually assimilated by the plants.

The following methods were followed to estimate the quantities of the food substances that could be readily assimilated. I. — Extraction by steam (500 gm. of soil being treated for 5 hours with 4 litres of water under a pressure of 5 atmospheres). II. — Extraction with a 1 % solution of citric acid.* The results obtained by the two methods are clearly too high if they are compared with the amounts actually assimilated by the plants. From 6 soils analysed, only 19.09 % to 61.80 % of the potash content (as determined by extraction with water-vapour), and 12.62 to 24.91 % (as determined by method II), was used by the potato. The values for phosphoric acid were still lower.

The author considers this result was due to the unusual dryness of the season

The ratio, potash : nitrogen : phosphoric acid in the case of the potato can also be used for estimating the fertiliser requirements of the soil. This ratio should be determined from an average crop. The author gives the following figures as normal, 100 : 70 : 25. Thus, for every 1000 gm. of the dry matter harvested, the values ought to be : potash 25 gm., nitrogen 18 gm. and phosphoric acid 6 gm. A much higher, or lower, ratio for any of these three nutritive substances indicates an excess, or a lack, of it in the soil.

The author is of opinion that by means of steam extraction, or the 1 % citric acid method, accurate data as to the manurial needs of soil can be obtained

Experiments with oats. — The experiments made with oats showed the author that the amount of potash removed by these plants from the soil can be estimated more or less correctly by adopting the steam-extraction method, as he obtained concordant values by this means

The amount of phosphoric acid absorbed was lower than that extracted by steam ; the plants only assimilated 14 % to 15 % of this quantity.

When the phosphoric acid was extracted with 1 % citric acid, it was found that the plants absorbed 20 % of the quantity found in the soil

These experiments were also carried out in order to calculate in advance the manurial requirements of the soil

D. v. S.

561 Contribution to the Study of Variability in the Schizomycetes.

ROSSI, G. *Annali della R Scuola Superiore di Agricoltura in Portici*, Vol. XVIII, 1923, Portici, Delle Torre

The author states that studies of variability in the Schizomycetes are multiplying and that while, on the one hand, there is a tendency to believe with Gino DE ROSSI that experimental proof is lacking of the formation of new bacterial species, or varieties, or of the transformation of one species into another as a result of mutation, there is no doubt that the Schizomycetes have a considerable propensity to modify their morphological, and especially their physiological, characters under the influence of external stimuli, so as to produce new varieties. Some observers go so far as to believe with LOHNIS, HANZAWA and SMITH, in the passage of one species to another, and even in polymorphism which needs for its support a theory of bacterial morphology totally at variance with our present views. This is based on the existence of new reproductive organs in bacteria (gonidia), or rather, a different interpretation of already-observed morphological characters, as well as the formation of a *sympiasm*, *corpi rigeneratori*, zygospores and a whole series of conceptions which would overthrow the classical bacteriology of Louis PASTEUR and Robert KOCH and lead us back to some extent to the views held by NÄGELI and DE BARY.

The author has observed in a line of *B. bulgaricum*, a cyclic and periodic variation arising in days, months or years and affecting not only the

form of the micro-organism, but also the character of the colony. To enter more into detail :

1) The *B. bulgaricum* used by the author was totally different according to whether it was cultivated on solid, or liquid media ; in the first case, it assumed a short, thick shape 2-3 μ in length and 0.2:0.3 μ thick, while in the second, it inclined to an elongated shape and was at least 4-5 μ in length.

2) The passage from one form to the other is effected slowly if the bacterium passes from a solid medium to a liquid one, and in 20 days at least, during 4-5 passages, from one liquid medium to another.

3) When cultivated in liquid media, the shape of the bacterium varied from short to very long, 40-50 μ , but in all cultures, the short and very short forms occurred while the very long forms made their appearance at certain periods which, however, could not be precisely defined

4) On solid media (potato, agar), the colour of the colonies was at times yellow and at others white, not alternately, or suddenly, but according to periods that might last for years. Intermediate forms were not lacking

5) In liquid media, the forms called by most scientists involution forms were observed (these were respectively like a blister, or club-shaped, either thick or curved) which were easily identified with the zygosporcs, gonidia, and *corbi regeneratori* of LÖHNIS

The author proved that the latter can no longer be regarded as degenerate forms, since they occur when the culture is in the best and most normal conditions of existence, but their presence is very variable, since many years may pass without their making their appearance, whereas at other times, they are extremely numerous. For this reason, it is considered that even according to the new theory advanced by LÖHNIS, their signification is still far from being explained.

G. R

Plant Breeding

562 **Some Effects of Physiological Conditions on Genetic Characters of Wheat.**

GERICKF, W. F., *American Journal of Botany*, Vol. X, No. 6, pp. 275-
Lancaster, Pa., 1923.

The relative earliness or lateness of maturation of wheat, and the awned or awnless form of the spikelets are two classes of genetic characters used by agriculturists to distinguish individual varieties. Under normal conditions of field culture these characters are fairly fixed in pure line strains. They change, however, with conditions of nutrition and external environment and this has been proved by the recent investigations here reported.

On December 15, 9 different varieties of spring wheat, representing a range from early to late types, were sown and kept under greenhouse conditions, these matured normally, the earliest in the last week of April and the latest 7 weeks after.

On March 20, another series of cultures under glass was made, but using tap water as the growth medium, which is very deficient in salt nutrients. To each culture at the beginning of the experiment was added a minute quantity of ferrous sulphate. All the varieties matured and produced grain, naturally only to a limited extent. The earliest variety matured during the last week of June, and the last during the first week of August. The order of maturity varied according to the soil and medium. For example, the variety "Bunyip" passed from the earliest (grown in soil) to the 5th earliest (using tap water). It is interesting to compare the changes occurring with other varieties hitherto considered to be mutant.

G. A.

563. Research on a Speltoid Mutation of Wheat

LINDHARD E. Fortgesetzte Untersuchungen über Speltoidmutationen. *Hereditas*, Vol IV, Parts 1-2, pp. 206-220. Lund, 1923

Amongst the offspring of the normal type (Squarehead) of wheat heterozygous speltoid mutants make their appearance; these may give rise by successive mutation to heterozygous forms of *Compactum* which may in their turn, produce heterozygous Squarehead types. It was possible by means of a series of crosses between these mutants to establish the following structural formulae: $N \times H = \text{normal type}$; $Sp \times H = \text{heterozygous speltoid type}$ $Sp \times C \times N = \text{heterozygous } Compactum$ and $Sp \times SpC = \text{heterozygous Squarehead}$.

The three last heterozygous types form a species of triangle that can only be explained by the theory of multiple allelomorphs, inasmuch as a cross between any two of these types can produce the heterozygous form of the third. The preliminary researches made by WINGE on the histology of these mutants would lead us to suppose that the heterozygous Squarehead Sp , $Sp.C$, and the heterozygous *Compactum* $Sp.CN$ possess 41, instead of 42, chromosomes. The gamete *Compactum* $Sp.C$ would appear to have 20, instead of 21, chromosomes, in other words, it is nothing but a speltoid gamete minus a certain chromosome. If this hypothesis was confirmed, the question of the relations between the different forms would to some extent be solved.

On crossing a mutant, heterozygous type of *Compactum* with the normal, awned form ($USpC \times uN$), the resulting hybrid should have eight $USpC$ gametes to every one $USpC$ gamete, while the hybrid $SpC \times U N$ ought to produce 8 $uSp.C$: 1 $USpC$ which is what actually occurs.

This correlation between the factor U and the absence of one chromosome (an absence which produces the *Compactum* form), could be explained by supposing that some chromosomes do not separate according to the law of probability, but tend to more *en masse* towards one or other pole.

G. A.

564. Length of Rachis Internodes and Number of Spikelets in the Progeny of Speltoid and Heterozygous Forms of Wheat.

KAJANUS BIRGER Über Ährchenabstand und Ährchenzahl bei Nachkommenschaften von Speltoidi-Heterozygoten *Hereditas*, Vol IV, Parts 1-2, pp 10-16 Lund, 1923

This paper gives the results obtained from some researches on the length of the internodes of the rachis and the number of spikelets in the progeny of speltoid and heterozygous forms of wheat. The increase in the length of the internodes and the smaller number of spikelets in the series *Vulgare* — heterozygous — speltoid is clearly seen in the F_2 of *vulgare* \times speltoid, in which the heterozygotes present intermediate conditions. From a summary of the data referring to the length of the internodes (distance in millimeters between the insertion of the spikelets) the plants may be divided into 11 classes according to internode lengths ranging from 3.1-3.5 to 8.1-8.5

	3.1-3.5	3.6-4.0	4.1-4.5	4.6-5.0	5.1-5.5	5.6-6.0	6.1-6.5	6.6-7.0	7.1-7.5	7.6-8.0	8.1-8.5	Sum	Average
<i>Vulgare</i>	—	2	23	48	28	2	—	—	—	—	—	103	4.32
Heterozygous	—	—	1	17	76	93	40	8	1	—	—	236	5.20
Speltoid	—	—	—	2	4	22	53	40	8	1	1	132	5.95

As regards number of spikelets, there is an average of 21.63 for *Vulgare*, 20.75 for the heterozygotes and 20.04 for the speltoids.

G. A.

565. Banats Wheat.

NIKOLIČ, M Banatska psenica *Zeitschrift für Pflanzenzüchtung*, Vol IX, Part 1, p 71 Berlin, March 1923

Banats wheat (Banater Weizen) belongs to *Triticum vulgare aristatum*, var. *erythrospermum*. The ears are reddish-brown, slender, and attain a length of 15 cm. The kernels are brown and often have a bluish-grey, waxy covering, the fracture is flinty. The straw is strong and of a yellowish-red colour. This wheat is early and resistant to cold. Numerous modifications and types suited to various conditions of environment have been obtained from it. These may be divided into three classes, red, white, and brown. The red type is hardy, of vigorous growth, has large ears and ripens relatively late; the white type is more delicate, while the brown, which is much rarer, more nearly resembles the red type.

To the Banats group of wheats belong: the Banats wheat properly so-called and the Theiss and Somogyer wheats (the last grows in Slavonia)

G. A.

[564-565]

566. The Origin and Genetic Composition of Types of Smooth-Awned Barley.

N. O. VAVILOV Происхождение члaddockотных Яруменой Труды по прикладной Ботанике. Year 12, Part 1, pp. 53-125 table 1, Petrograd, 1922.

The varieties of barley cultivated in Europe and Asia are characterized by the roughness of their awns caused by the presence of epidermal processes anatomically identical with hairs, having cells with a high salicylic acid content.

In 1908, REGEL drew the attention of botanists to the existence of barleys with smooth awns, a structural peculiarity which makes them more suitable for forage, as they are more appetising than awned barleys, and not so apt to stick in the throats of the animals.

At the present time, 19 strains of smooth-awned barleys are known all of which are either two or four-rowed. In agricultural literature, these smooth forms are regarded as loss-mutants due to the sudden suppression of the genetic factor determining roughness, although this hypothesis has not been actually proved.

The present paper contains the results of a series of crosses and genetic analyses made with the object of studying phylogenesis in barley and the origin of forms with smooth awns.

In the F_2 of a rough form, some quite smooth individuals occur, and in certain crosses the number of such individuals is very large while in others it is very small. It is therefore possible to obtain smooth-awned barleys by synthesis. The following table gives an instance of this and summarises the data referring to the F_2 generation of such crosses between rough barleys which in some cases have produced smooth individuals

25 crosses were made in all, and the offspring of 13 of these were smooth-awned. In the course of this work it was found that the character "smooth" is dominant to "rough".

In addition to the genetic tests, numerous anatomical and histological investigations were made for the purpose of determining points connected with shape, size and the distribution of roughness. The results showed one important fact viz., that smooth-awned forms only appeared in the hybrid progeny obtained by crossing rough-awned types when the awns of the parental forms possessed certain structural characters.

It was necessary in order to obtain these smooth individuals, for one of the parents to have slender awns with triangular section, and wide-apart, acicular teeth arranged in a close spiral (group *nutans colchicum* and *nutans precocius*), while the other parent must possess broad awns with large, closely-set teeth disposed in a loose spiral and occurring not only on the edges, but also along the external median line of the awn (*coelestis* and *nudoficiens* group).

In many cases, however, in spite of this difference between the parents, the smooth form does not make its appearance, while on the other hand, it may occasionally arise when the differences between the dentition and the awns are not very marked. The problem is evidently complicated.

The numerous crossing experiments (made in 1915 by the author),

between ordinary rough barley and the smooth barleys of Russia and Persia produced smooth and rough individuals in the most varying proportions the F_2 , viz, 5 : 1 — 78 : 1 — 21 : 1 — 16 : 1 — 07 : 1 — 09 : 1 . . .

The differences obtained in the numeric relations by crossing the various lines of barley reveal the existence of substantial differences in the genetic structure of the various lines and in the number of factors co-operating in the production of roughness

	Total number of plants	Plants with rough awns	Plants with semi rough awns	Plants with almost smooth awns	Plants with smooth awns
♀ <i>Hordeum distichum</i> var <i>mutans</i> <i>colchicum</i> R. Regel × <i>H. vul-</i> <i>gare</i> var <i>coeleste</i> Walpersii R. Regel .	202	149	—	—	23
♀ <i>H. d.</i> var <i>mutans colchicum</i> R. Regel × ♂ <i>H. v. pallidum</i> <i>mandchuricum</i> R. Regel .	293	208	4	4	67
♀ <i>Hordeum c.</i> var <i>pallidum ac-</i> <i>tivum</i> R. Regel × ♂ <i>H. d.</i> var <i>zeocrithum</i> . .	79	76	2	—	1
♀ <i>H. v.</i> var <i>pallidum lappon-</i> <i>icum</i> ♂ <i>H. d.</i> var <i>mutans prae-</i> <i>cocius</i> R. Regel	158	125	11	3	14
♀ <i>H. d.</i> var <i>mutans colchicum</i> Regel × ♂ <i>H. v.</i> var <i>pall-</i> <i>idum activum</i> Regel	39	30	2	3	4
♀ <i>H. d.</i> var <i>mutans precocius</i> R. Regel × ♂ <i>H. v.</i> var <i>pallidum jarengianum</i> R. Re- gel .	105	105	—	—	—

Hence, the genetic formula is no less complicated than the morphological complex discovered by the anatomic study of the awns and dentition.

Many interesting phenomena of attraction and repulsion have been brought out by crossing smooth and rough varieties of barley. A good instance of the latter is afforded by a family belonging to the F_3 generation of the cross No. 145 *Hordeum vulgare* var. *nicotense* Kiarchanum R. Regel × No. 154 *Hordeum vulgare* var. *coeleste* pamtricum Vav.

In this family, segregation is shown by the characters of the grain and of the awns. The combination of these qualities, however, instead of following the law of probabilities, takes place as if there existed some incompatibility, or repulsion, between "covered" grain and rough awns. All the plants with "covered" grain (19 out of 55) had smooth awns.

In other families of the same cross, cases of repulsion not infrequently occurred between smooth awns and "exposed" grain, but they were not so absolute as in the first instance.

Attraction sometimes occurs between the character smooth-awned and two-rows of grain.

Thus, from No. 141 *Hordeum vulgare* var. *pallidum lapponicum* R. Regel \times No. 55 *Hordeum distichum* var. *nutans praecocius* R. Regel, 158 plants were obtained in the F_2 . Of these, 43 were four-rowed barleys, 11 intermediate (but nearer to the four-rowed type), 61 two-rowed (but of a transitional, intermediate type) and 43 typically two-rowed.

As regards the awns, 136 plants had rough awns and 22 smooth-awns.

Of the latter 22, 13 were of the *nutans* type (two-rowed), so there is a certain attraction between smooth awns and two-rows of grain.

Number of genetic factors — The examination of the third generation reveals the presence of a larger number of factors than could have been expected from the data obtained from the second generation. Thus, in the F_2 generation, only rough plants (134) resulted from the cross No. 36 (*Hordeum distichum* var. *deficiens* \times No. 154 *Hordeum vulgare* var. *coeleste*), while many smooth individuals appeared in the F_3 . In this case, at least, 4 factors must have come into play. If there had only been 3 in the second generation; two out of the 132 plants would have been smooth (according to the ratio 63 : 1). A series of similar facts have led the author to estimate the factors producing roughness at 5, or 6, at the minimum.

The appearance of smooth plants in the F_2 , or F_3 , of rough parents may be regarded as due to the crossing of forms with a different genetic structure from the standpoint of awns.

If we represent the factor of roughness by Z_1, Z_2, Z_3, Z_4, Z_5 , and the absence of roughness of its factor by z_1, z_2, z_3, z_4, z_5 we shall obtain in the F^2 on crossing a Z_1, Z_1, Z_2, Z_3, Z_3 individual with a $z_1, z_1, z_2, z_2, Z_3, Z_3$ plant, $z_1, z_1, z_2, z_2, z_3, z_3$, individuals all with smooth awns. When the two parents have a larger number of factors ($Z_1, Z_1, Z_2, Z_2, z_3, z_3, z_4, z_4, \times z_1, z_1, z_2, z_2, Z_3, Z_3, Z_4, Z_4$), then naturally, in order to obtain smooth types in the F_2 , it would be necessary to have at disposal a larger quantity of material, since otherwise there would be no probability of obtaining combinations with the character smooth awnness.

Without excluding the possibility that smooth awns may be due to mutation, we are inclined, after what has been said, to attribute their origin to a series of simple and very probable crosses. The barley is generally a self-fertilising plant with closed flowers. Sometimes, however, spontaneous staurogamy takes place, which is facilitated both by the structure of the flowers and by the climate. A hot, dry climate is favourable to anthesis, and thus encourages cross pollinisation, especially in the case of varieties of which the flowers tend to open widely, as for instance *Hordeum spontaneum*, and some varieties of *coeleste* which the author had an opportunity of observing at Saratov, in 1918.

Varities of smooth-awned barleys have been hitherto found in Persia,

the Caucasus, and South Russia, where the conditions are such as to facilitate cross-fertilisation. These conditions are as follows :

1) Mixed Sowing : The barley crops of these regions are composed of a mixture made up of the most varied forms with two or four rows of grain, black or yellow ears, naked or covered grain.

2) Hot, dry weather from the period of heading.

3) Presence of two or four-rowed varieties which by crossing give rise to the smooth forms : *Hordeum distichum* var. *nutans colchicum*, *nutans praecocius nudoficiens*, and some types of *coelestes* and *pallidum*.

Thus, it is most probable from the experiments made by the author that smooth-awned barleys have arisen as a result of crosses between rough-awned forms. G. A.

567 A Probable Loss-Mutation in *Pisum*.

TEDIN HANS. Eine Mutmassliche Verlustmutation bei *Pisum Hereditas*, Vol. VI, Parts 1-2, pp. 33-43. Lund, 1923.

The Schrot pea is a strain of *Pisum arvense* with the usual characters of the species viz., red flower, large, red, somewhat wrinkled seeds with spermoderm of different shades ranging from greyish-yellow to brownish-grey.

By means of pedigree selection, numerous lines were obtained from this strain one of which, No. 0301 is worthy of special attention ; it is distinguished by having a smooth skin and a transparent, almost completely colourless, spermoderm, the only character that recalls *arvense* being a small triangular brownish-grey patch above the chalaza. From this patch two narrow strips of the same colour are given off that develop at a certain distance one on each side of the hilum.

The colour of the flowers in *Pisum arvense* is due to three factors : *A*, *B* and *C*. *A* which is the basal colour factor produces of itself a bright purple tint ; *A* + *B* gives pink ; *A* + *C*, violet ; *A* + *B* + *C* normal red.

In the case of the spermoderm, two factors *G* and γ , would appear according to the author, to come into play. The first when in conjunction with *A* would seem to act as a relatively weak chromogen giving rise to a slight brownish coloration, while the other which is inactive alone, accentuates the colour to a dark brown.

G and *A* are connected, or actually identical. The crossing experiments made by the author have revealed the presence of a third factor *G*₁ in the absence of which the coloration of the spermoderm is reduced to the two bands characteristic of 0301.

In the same manner, in order to obtain the wrinkling of the seeds it would be necessary in addition to the factors *L*₁, *L*₂. (Tschermak) to have also *C*.

If *C* is lacking in the genetic complex of *arvense*, we have a type with characters corresponding exactly to the line 0301.

The origin of this line may be explained by regarding it as a loss-mutation due to the lack, or inaction, of the factor *C*.

G. A.

[567]

568. **New Observations on the Genetics of Peas.**

PELLEW, CAROLINE and SVERSRUP ASLAUS, *Journal of Genetics*, Vol. 13, No. 1, pp. 125-131, figs. 4. Cambridge, March 1923.

This paper gives the results obtained by a genetic study of two varieties of peas (*Pisum sativum*).

1) *Variety with reduced stipules*. — This variety is distinguished by possessing stipules little larger than those of *Lathyrus*. It was obtained from a mutant discovered in 1915 amongst the plants in a row of Duke of Albany peas. From the seeds of this plant were raised 20 seedlings all with reduced stipules. This reduction appears to be connected with a greater development of the leaflets. Crossing this form with the Duke of Albany gave normal types in the F_1 , while the F_2 was composed of normal individuals and plants with reduced stipules in the proportion of 3 : 1.

S represents the factor producing normal stipules (s standing for reduced stipules) and is linked with the purple colour B as can be deduced from the hybrids resulting from the cross $Bs = bS$. The percentage of cross-overs is 28.

2) *Variety with keeled alae*. — The alae are modified, having the structure and appearance of the keel; the structure of the flower is normal in other respects.

K, normal alae (k = keeled wings) is correlated with G, glaucous colour (g = emerald green). The percentage of cross-overs is 20.

No correlation exists on the other hand between S and G; S and K are therefore situated in two different chromosomes.

K and S, are in their turn independent as regards the following genetic values.

linked	round-wrinkled seeds, tendrils, leaves acacia type.
	stem tall-dwarf
	stem normal-fasciate
	flowers-white-coloured
	cotyledons yellow-green.

Thus we have for *Pisum* three linkage groups (the haploid number of chromosomes is 7).

1	{ seeds, round-wrinkled
	{ tendrils, leaves acacia type
2	{ flowers, purple-salmon
	{ stipules normal, stipules reduced
3	{ glaucous-emerald-green
	{ normal alae-keeled alae.

In the course of his work on the colour of the cotyledons and pods, the author discovered a series of interesting facts that can be explained by assuming the existence of a triple series of allelomorphs: 1) yellow cotyledons (dominant character) associated with green pods; 2) green cotyledons associated with green pods; 3) pale-green cotyledons associated with green pods.

G. A.

569. On the Genetic Characteristics of the Gametes of the Sweet Pea.

HAMMARLUND, C. Über einen Fall von Koppelung und freie Kombination bei Erbsen. *Hereditas*, Vol. IV, Pts. 1-2, pp. 235-238. Lund, 1923.

Two pure lines of the sweet pea were employed :

1) *Pisum sativum saccharum* (Plots 306-18) distinguished from the common sweet pea by the white petals and golden coloured hood.

2) *Pisum arvense saccharatum* (Plots 460-18), petals violet and green seeds.

Cross A. The F_1 of the cross ♀ 306-18 × ♂ 460-18 consisted of 10 individuals with violet petals and green seeds and in F_2 a fourth consisted of normals with violet flowers and green pods ; violet petals and yellow seeds ; white petals and green seeds ; white petals and yellow seeds, in the following ratios 9 : 3 : 3 : 1. The difference between the two lines is evidently due to two independent genetic factors.

Cross B : ♀ 306-18 ♂ 460-18 ; the ♀ parent the same as the preceding cross ; the ♂ parent various, but coming from the same mother stock as the ♂ parent in Cross A, and morphologically identical. In F_1 the hybrids gave violet petals and green seeds ; in F_2 , however, the proportion was distinctly variable : 226 violet-green ; 2 violet-yellow : 4 white-green and 83 white-yellow. The predominant characters are violet-green and white-yellow.

Cross C : ♀ 460-18 × ♂ 306-18.

The F_1 gave similar results to cross B 201 : 3 : 4 : 70.

In crosses B and C therefore, there is an evident correlation "Koppelung" between the two factors with violet petals and violet coloration of the seeds, in such a way that the gametes show a predominance at least four times superior to that of the gametes responsible for the white coloration of the petals and the yellow coloration of the seeds.

G. A.

570. The Genotypic Relations between the Wild Form, *Linum angustifolium* and the Cultivated *L. usitatissimum*.

TAMMES TINE. Das genotypische Verhältnis zwischen Idem Widen *Linum angustifolium* und dem Kulturlein, *Linum usitatissimum*. *Genetica*, Year V, Part 1, pp. 61-70, table 1. The Hague, January 1923.

Seven factors : A, B, C, D, E, F and H, are involved in the colour of the petals and of the anthers of the cultivated variety of flax (*Linum usitatissimum* L.) B' and C' are the basal determinants of the colour of the flowers, the presence of both being necessary in order for the petals to be tinted. H in combination with the two preceding factors imparts a blue colour to the anthers and the pollen, while the effect of all the other factors is to intensify the coloration, or produce different shades.

Taking this point as a basis, the author has begun a series of similar genetic determinations in the case of wild flax *Linum angustifolium*, which, like the cultivated variety, has a diploid number of 30 chromosomes. In the wild flax also, seven genetic factors have been determined for the colour

of the petals (A^a , B^a , C^a , D , E , F^a and H) and one other factor has also been found in the case of both species (K and K^a respectively).

The factors met with in the two species are very similar not only as regards the characters they determine, but also from the point of view of the reciprocity of their effects. In so far as the difference amongst the factors is concerned, this is of three kinds:

- 1) qualitative: the shade of colour produced by B^1 and C^1 with F differs from that due to B^a C^a and F^a ;
- 2) quantitative: B^1 , C^1 with F give a darker shade (the colour is the same, but its intensity is greater) than B^a C^a and F^a ;
- 3) differences as regards the dominance of the characters.

The differences that exist between the factors of *L. usitatissimum* and *L. angustifolium* do not prevent any factor in either complex being replaced by the corresponding factor in the other complex, the action of the rest remaining unchanged. Hence, it is possible by crossing the two species to obtain all the possible combinations, and since the two forms are distinguished by five factors, the genotypes in the F_2 will amount to $3^5 = 243$. Further, the incomplete dominance of the factors causes corresponding phenotypic differences while the great oscillations to a certain extent remove the limits between the different phenotypes. The absence of well-defined F_2 groups made the work of genetic analysis very difficult. The author has already mentioned the great similarity between these two species of flax:

- 1) Both are homostylic (all other varieties are heterostylic).
- 2) The greater the space at the disposal of the plant, the larger are the number of branchings at the base in both species.
- 3) These are the only two species of the genus *Linum* that can be successfully crossed.

Another point of likeness is the identity in the number of chromosomes, to which must now be added the unity of the genotype for the flower colour. In spite of the considerable phenotypic differences, the fact that the corresponding genotypes are composed of the same factors, or of allelomorphs, is a proof of the existence of a fairly close degree of relationship between the wild and the cultivated species.

The author is continuing his work and hopes soon to be able to give some results relating to the colour of the seeds, leaves and stem; the branching, length of stem, productiveness, duration of life, etc.

G. A.

571. Crosses between two Varieties of Cucumber, Znaim Gurke and Noa's Treib.

048 BECKER- J. Über Vererbungsgesetze bei Gurken. *Zeitschrift für Pflanzenzuchtung*, Vol. VIII, Part. 3, pp. 290-293. Berlin, 1922.

This paper gives the results obtained by a cross between two varieties of cucumber, the Znaim cucumber and Noa's Treib, the maternal parent being the former. The Znaim cucumber grows in the open and is especially cultivated by the inhabitants of Znaim in Moravia; it is oval,

and has no neck ; average length 18 cm. ; circumference 28.5 cm. ; weight 650 gm. The colour of the fruit is at first dark-green without stripes, but it turns yellow when ripe, the skin is glossy and bears a few black spines.

The paternal parent used in the cross, Noa's Treib, grows in a hot-bed. This variety was put on the market by Dümpele, in 1880 at Erfurt. Average length of fruit 65 cm., circumference 35 cm. , weight 4 kg. Colour green at first, later white. The skin is glossy with a few white spines.

We have therefore the following groups of colours :

Small fruit	Very large fruit
Green skin	White skin
Black spines	White spines

The F_1 and F_2 were grown in the open. The hybrids of the F_1 had striped, greenish-white fruits turning white when mature. The length ranged from 39 to 41 cm.; the circumference from 31 to 32 cm. and the weight from 1810 to 1910 gm. The spines were white. They thus showed characters intermediate between those of their parents.

In the F_2 , 76 individuals were obtained, the length and colour of these being as follows :

35-40 cm. long, white	44 plants
35-40 " " yellow	15 "
15-20 " " short, white	11 "
15-20 " " yellow	1 plant
20-35 " intermediate white	3 plants
20-35 " " yellow	2 "
<hr/>	
76 plants	

Leaving out of account the five plants of intermediate length due in the opinion of the author to the local action of the medium, we have : long-white ; long-yellow ; short-white ; short-yellow =

$$44 : 15 : 11 : 1 = 9 : 3 : 3 : 1$$

This gives the scheme of a dihybrid, the long shape being dominant as regards the short, and white dominant in respect to yellow (at maturity).

The objects of the cross which were to obtain a type of out-door, hardy cucumber with large well-formed fruit turning yellow when ripe, may thus be said to have been attained. In some of the individuals of the F_3 (1/16 of the progeny of F_2) and of later generations these groups of characters should remain constant. G. A.

572. Self-Sterility in Chinese Cabbage (Pe Tsai).

YOICHI KAKIZAKI, *The Journal of Heredity*, Vol. XIII, No. 8, pp. 374-376, fig. 1. Washington. D. C., December, 1922.

The experiments conducted by the author showed that, whereas cross-pollination gave rise to great fertility, self-pollination caused a high degree

of sterility, only 30 % of the self-fertilised flowers produced normal fruit, 27 % of the fruit being imperfect, while 50 % of the flowers did not set at all.

These results were obtained both when the pollen used was from the same flower, and when it came from the same, or other inflorescences of the same plant. In the experiments taken as a whole, very great individual variations were noticed ; these ranged from almost complete self-sterility to a very high degree of self-fertility which would incline us to suppose the existence of lines endowed with different grades of self-sterility.

When cross fertilisation was effected, the percentage of flowers that set reached 96.

G. A.

Seeds.

573. The Minimum Temperature of Germination of Seeds.

COFFMAN, F. A. (Office of Cereal Investigations, Bureau of Plant Industry, U. S. Dep. of Agr.) *Journal of the American Society of Agronomy*, Vol. XV, No. 7, pp. 257-270, bibliography. Albany, N. Y., 1923.

Little information apparently exists upon the subject of minimum temperatures of germination of seeds of most of our commonly grown plants. The author's objects in these experiments were to determine : 1) The minimum temperatures at which seeds of different common crop plants would germinate ; 2) the minimum temperatures at which satisfactory percentages of germination may be expected and the variations between such temperatures in different crops ; 3) whether lower temperatures than those commonly used in seed testing laboratories would be beneficial in the germination of seeds.

Seeds of different species germinate very differently at different temperature. Within a given species, starchy seeds appear to be unable to resist low temperatures to the same degree as the more oily seeds, without injury and reducing germination percentages. All of the small grains will germinate at the temperature of melting ice. Oats appear to be more affected by low temperatures than the other small grains. The strength of germination under freezing conditions appear to be in the following order : barley, rye, wheat, oats. It has been noticed that under field conditions spring barley and rye will germinate more quickly than spring wheat and oats during seasons of low temperatures. Of the sorghums, the softer and more starchy varieties appear less able to withstand low temperatures than the harder seed types. Of our commonly grown crops, the seed of alfalfa and the clovers will germinate more readily at low temperatures than any of the others. From the results obtained in these tests it appears that it would be advantageous to use lower temperatures for the germination of alfalfa, clovers, and cereals than those now employed in seed testing laboratories.

D. v. S.

574. Experiments in Dressing Seeds.

LEGGIERI, L. (R. Scuola Superiore di Agricoltura di Portici, Laboratorio delle Coltivazioni). Preparazione dei semi prima della semina. Esperimenti colla canapa e col granturco. *Il Coltivatore*, Year 69, No. 24, pp. 170-175, No. 25, pp. 206-212. Casale Monferrato, 1923.

The author has tested the following treatments in the case of hemp ("nostrana" variety), and maize ("giallo comune").

1. Immersion for 6 — 12 — 24 hours in: water; 1 % and 3 % solutions of sulphate of potassium; 1 % and 3 % solutions of ammonium sulphate; 2) Coating them with meat-meal + plaster.

He ascertained that: 1) the immersion of the seeds in water has a good effect; 2) the action of the salt solutions varies according to the seed, nitrate solutions having a favourable effect upon maize seed, and sulphate solutions suiting hemp seed best; 3) coating the seeds with an organic substance gives good results; 4) the duration of the immersion is a matter of great importance, hence the length of time needed must be found experimentally for each species, and perhaps for each strain, before any certain data can be obtained.

F. D.

575. Drying and Cleaning of Sugar Beet Seeds.

DESPREZ, F. (Directeur de la Station expérimentale agricole de Cappelle. Templeneuve) I. Culture de la graine de betterave sucrière. *Journal d'Agriculture pratique*, Year 87. Vol. II, n. 32, pp. 110-112. Sechage et nettoyage des graines de betteraves sucrières. *Idem*, Vol. II No. 35, pp. 170-172. Paris, 1923.

The unsatisfactory germination of sugar beet seeds has frequently been attributed in France to climatic conditions, excess of humidity, etc.

The author considers, however, that insufficient attention has been given to seed drying appliances and selection of seed. A test was made with seeds cleaned and dried before sowing, with threshed undried seed, and with seed merely dried. The seed threshed late and left undried gave a germination as low as 30 % whilst the dried samples showed a germination percentage of 75 %. Certain drying machines in use have proved ineffective owing to incomplete drying. Attention is drawn to the fact that seed is often considered dry prematurely from the appearance of the seed coat; the author states that all seed with a moisture content of 15 % requires further drying.

The losses incurred through inadequate drying have resulted in the formation of a Commission appointed by the Ministry of Agriculture in France with a view to the improvement and generalisation of special drying processes for sugar beet seeds. The Tripette and Renaud drier has proved satisfactory in various seed establishments and are recommended. These consists of a bin divided into 3 sections in each of which is placed an octagonal iron cylinder; the speed of rotation is regulated as required.

External fixtures direct the seeds towards the outlet and the rate is controlled according to the degree of humidity. The seed is eventually passed along into a hopper placed above a dryer and by means of a projector is pushed into the upper cylinder. It passes successively through 3 cylinders, a warm air current being directed through each; a ventilator is so arranged as to allow the warm air to escape through a chimney, and pipes and taps serve to regulate the direction of the current. The temperature may be controlled by inlets in the different sections.

A preliminary cleaning is advisable, to remove pebbles, twigs, etc. The actual drying process demands constant supervision as it is advisable to maintain the moisture content of the seeds at about 14 %. SAILLARD (General Secretary for the Commission) states that the gas currents give better results than the stove or kiln. To ensure simultaneous drying for all the seeds will depend largely on the type of drier, stage of ripeness, and degree of humidity and air circulation. Well matured seeds not too moist, readily withstand a high temperature. Experiments were made to test the influence of heat on germination of sugar beet seed. Three grades of seed were examined. A temperature above 80° C. will destroy inferior seeds and should serve as an adequate test for selecting good seed; kept for 1 hour at 80° for 14 days had no effect on germinating capacity of first quality seed although naturally it had a somewhat retardive effect. These results are only applicable to the effect of heat on vitality and not as regards preservation of the seed coat etc.; too high a temperature besides lowering the rate of germination will make the seeds excessively dry and brittle.

After drying, the seeds are passed through a grader, the sieve retaining only seeds of 2.5 mm. and a tilted sheet so arranged as to finally direct the inferior and good quality seed into their respective sections. Before putting into packets, the seed is placed in a thin cloth and exposed to the air to ensure elimination of any dust particles.

M. L. Y.

BIBLIOGRAPHICAL NOTES.

576. AUCHINLECK, G. G. DRIEGBERG, J. G. and KADRAMER, R. D. Calculation of the Probable Soil Error in Paddy Trials. *The Tropical Agriculturist*, Vol. LX, No. 5, pp. 275-279, Tables 4, fig. 1. Peradinya, Ceylon, 1923.

The authors give an account of work carried out at Peradinya to determine the errors which arise from initial differences of fertility in various parts of a field, and lessen the value of comparative experiments. A frequency curve of the yield from the paddy plots is given and the average deviations, standard deviations and probable errors, obtained in the trials with various groupings of plots are set out in a table, so that comparison may be made.

W. S. G.

577. ARND, TH., Ein neues Verfahren zur vergleichenden Bestimmung der Kohärenz mineralischer Böden. (New Method of determining the Cohesion of Mineral Soils). *Zeitschrift für Pflanzenernährung und Düngung (wissenschaftlicher Teil)*, Vol. II, No. 2, pp. 130-149, figs. 8. Leipzig, Berlin, 1923

The author describes a new method of determining the cohesion of mineral soils, by means of an apparatus he has devised with which he estimates the resistance to friction. One prism and one cylinder made from the soil to be tested are fixed in the apparatus. By means of a rotory movement, the cylinder is rubbed against one of the surfaces of the prism. The author distinguishes cohesion coefficients of the first, second and third order, according to the duration of the rubbing, the pressure applied and the rapidity with which the cylinder rotates.

D. v. S.

578. HENDRICK, J. and NEWLANDS, G. (Soil Research Department, University of Aberdeen, Scotland). The Value of Mineralogical Examination in determining Soil Types, with a Method of Examination and a Comparison of certain English and Scottish Soils. *The Journal of Agricultural Science*, Vol. 13, No. 1, pp. 1-17, fig. 1. bibliography. Cambridge, 1923.

The method of mineralogical analysis of soils is discussed as a useful means of examination for the purposes of classification; the results of the analyses are discussed and English and Scottish soil types compared.

D. v. S.

579. JOSEPH, A. H., and MARTIN, F. J. (Wellcome Tropical Research Laboratories, Khartoum). The Moisture Equivalent of Heavy Soils. *The Journal of Agricultural Science*, Vol. 13, No. 1, pp. 49-59. Cambridge, 1923.

The experiments here described were carried out on soils of the northern Sudan; their aim was to find the relation between moisture equivalent and such additional important soil properties as salinity and alkalinity.

D. v. S.

580. LINDEMAN, J., (School of Agriculture, Aas, Norway). Untersuchungen ein Eisenhydroxydsol; ein Fall negativer Osmose (Correlation between Osmotic Pressure and Concentration of Colloidal solution of Iron Hydroxydsol). *Kolloid-Zeitschrift*, Vol. 32, No. 6, pp. 376-383, figs. 3. Dresden-Leipzig, 1923.

This physico-chemical study, also of interest from the physiological standpoint, is concerned with the correlation between osmotic pressure and the concentration of a colloidal solution of iron hydroxydsol. It refers to a case of negative osmosis.

D. v. S.

581. ARND and TACKE. Physikalische und chemische Studien an schweren Tonboden. (Clay Soils from the Physical and Chemical Standpoint) *Internationale Mitteilungen für Bodenkunde*, Vol. XIII, Nos. 1-2, pp. 6-26. Berlin, 1923.

The authors have studied clay soils from both the physical and the chemical standpoints, and have also tested the effect of liming on certain physical properties of the soil, such as specific gravity, hygroscopicity, plasticity etc. Subsequently, they investigated the functions of alumina, silicic acid and bases in connection with phosphatic fertilisers. The soils studied are those of the marshes in the German coast of the North Sea. The results obtained were to a considerable extent negative.

D. v. S

582. MACINTIRE, W. H., and YOUNG, J. B. The Transient Nature of Magnesium-induced Toxicity and its Bearing upon Lime-magnesia Ratio Studies. *Soil Science*, Vol XV, No 6, pp 427-471, 5 plates, bibliography. Baltimore, 1923

It is pointed out that if plant culture experiments relative to the effects of the more active forms of magnesium are continued over a period of years, it may be true in many cases, that an initial period of toxicity may be converted into a period of beneficial results, as was found to be the case in the author's experiments.

D. v. S

583. WESTER, D. H. Über den Mangangehalt einiger holländischer Bodenarten und einige Bemerkungen dazu (Manganese Content of Dutch Soils) *Internationale Mitteilungen für Bodenkunde*, Vol. XIII, Nos 1-2, pp. 1-5. Berlin, 1923.

The author has determined the manganese content of a series of types of Dutch soil. There had been no data previously on this subject. It was found that the most fertile soils contain the largest amount of manganese, and that the ash of cultivated plants has a higher percentage of manganese than the soils themselves.

D. v. S.

- 584 WHITTLES, C. L. (School of Agriculture, Cambridge) The Determination of the Number of Bacteria in Soil (Preliminary Communication). *The Journal of Agricultural Science*, Vol 13, No. 1, pp. 18-48. plates 3, fig 5, bibliography. Cambridge, 1923.

The author criticizes the usual shaking methods, for the determination of the number of bacteria in soil, which have been examined and found unsatisfactory. The most striking result of the use of the vibrator, was the fact that the colonies grew so quickly. It is suggested that this is due to the organism having been freed from the enveloping colloidal gels, in which they are normally embedded.

D. v. S.

585. KOCH, A. and OELSNER, Alice. (Agricultural Bacteriological Institute, University of Göttingen, Germany). Über nucleoproteid spaltende Bakterien und ihre Bedeutung für die Erschließung des Phosphorkapitals. im Ackerböden. (Nucleo-proteins Bacteria and the Effect on the Transformation of Phosphorous, into Available Phosphate Compounds). *Biochemische Zeitschrift*, Vol. 134, Nos. 1-4, pp. 76-96. Berlin, 1922.

The authors have designated the soil bacteria which transform the phosphorous content of the organic nucleo-protein compounds into available plant phosphates as *Nucleobacter*. The action of these bacteria is accelerated when lime is added to the soil. D. v. S.

586. HEYMONS, R. (Zoological Institute of the Higher Agricultural School of Berlin). Der Einfluss der Regenwürmer auf Beschaffenheit und Ertragsfähigkeit des Boden. *Zeitschrift für Pflanzenernährung und Düngung (wissenschaftlicher Teil)*, Vol. II, No. 2, pp. 97-129, bibliography. Leipzig, Berlin, 1923.

An account of the influence of earthworms on soil structure and fertility D. v. S.

- 587 CURIE M^{de}. Electroscope pour la mesure de la radioactivité des engrais. (Electroscope for the Measurement of Radioactivity of Fertilisers). *Annales de la Science Agronomique*, Year 39, No. 5, pp. 267-264, figs. 1. Paris, 1922.

- 588 THOMAS, W. (Pennsylvania Agr. Exp. Station). Ultimate Analysis of the Mineral Constituents of a Hagerstown silty clay loam Soil and occurrence in Plants of some of the Elements found. *Soil Science*, Vol. XV, No. 1, pp. 1-18, bibl. 76, publ. Baltimore, 1923.

This paper gives an account of the preliminary work carried out on soil used in an intensive apple fertilizer experiment. The rare elements, vanadium, chromium, molybdenum, zirconium, rubidium, caesium and lithium have been isolated and identified. The question is raised: how do such relatively large amounts of the rarer elements become absorbed and assimilated by plants, and what function, if any, do they possess? The investigations are being continued. D. v. S.

- 589 KLITSCH, C. Die Wirkung einseitiger Düngung auf die Gestaltung der anatomischen, insbesondere der mechanischen Verhältnisse in Roggenhalmen. (Effect of Fertilisers on Anatomical and Mechanical Composition of Haulms of Cereals) *Zeitschrift für Pflanzenernährung und Düngung (wissenschaftlicher Teil)*, Vol. 2, No. 4, pp. 249-292, figs. 1, bibliography. Leipzig, Berlin, 1923.

The author treats of the effect exercised by the respective fertilisers upon the composition of the haulms of cereals, from the anatomical

and mechanical standpoints. The hardening of the haulms with a view to the keeping qualities of the straw is the principal subject of discussion. D. v. S.

590. ADINARAYAN RAO, K. Preliminary Account of Symbiotic Nitrogen Fixation in Non-Leguminous Plants with Special Reference to *Chomelia asiatica*. *The Agricultural Journal of India*, Vol. XVIII, Pt. II, pp. 132-143. Calcutta and London, 1923.

Report of investigations with leaf nodules of *Chomelia asiatica* and *Pavetta indica*, non-leguminous species common in Southern India, suitable as green manures. Examples of plants of other orders such as Rubiaceae, Myrsinaceae and Casuarineae are mentioned in this respect, and reference is also made to certain plants in temperate climates, e. g. *Alnus* spp., *Cycas circinalis*, *Elaeagnus latifolia*, and *Podocarpus latifolia*, which may be included in this category. M. L. Y.

591. ROBERTSON and DICKSON The Valuation of Insoluble Phosphates by Means of a Modified Citric Acid Test. *Chemistry and Industry*, Vol. 42, No. 8, pp. 59-66. London, February 1923. D. v. S.

592. HALL, T. D. The Nitrogen Problem. *The Farmer's Weekly*, Vol. XXV, No. 642, pp. 1562-1563. *Idem*, Vol. XXV, No. 646, pp. 1944-1947, figs. 6. Bloemfontein, 1923.

This article deals with the chemistry of certain South African soils, and the related factor of fertilisers. In the second part the results of experiments are given respecting the nitrification values of various soils, and deductions made from the data obtained. Graphs illustrate seasonal variations of nitrates, rainfall, soil and air temperatures, and the nitrogen content of soils treated in different ways. W. S. G.

593. CANNON, W. A. Plant Habits and Habitats in the Arid Portions of South Australia. *Carnegie Institution of Washington, Publication No. 308*, pp. 1 139, plates 32, figs. 31, bibliography. Washington, 1921.

The author gives a complete survey of the general physiological conditions of Australia, the climatic features and the vegetation and plant habitats in the arid portions in the south. Full details are included concerning the morphological characteristic of the plants and certain reactions and adaptations to different areas (reactions to light, temperature, low water-supply, physical nature of the soil). The numerous plates illustrate the conditions and habits very effectively. M. L. Y.

594. BRAUN-BLANQUET, J., and WILCZER, E. Contribution à la connaissance de la Flore Marocaine. (Moroccan Flora). *Bulletin de la Société d'Histoire Naturelle de l'Afrique du Nord*, Vol. XIV, No. 5, pp. 191-197; No. 6, pp. 212-226. Algiers, 1923.

General review of the various botanical expeditions made in different parts of Morocco and lists of the plants collected. F. D.

595. MAXIMOW, N. A., (Botanical Garden, Petrograd) Physiologisch-ökologische Untersuchungen über die Dürresistenz der Xerophyten. (Investigations on the Resistance of Xerophytes to Drought). *Jahrbücher für Wissenschaftliche Botanik*, Vol. 62, No. 1, pp. 128-144, bibliography. Zusses Leipzig, 1923.

An ecological investigation dealing with the resistance to drought of xerophytes, plants common in the desert and the steppes, and including also certain of the now-cultivated plants. Experiments were started at Tiflis in 1913 in a laboratory established by the author and which is still being carried on to study the flora of the Caucasus. D. v. S.

596. LUNDEGARDH, H. (Lund, Sweden). Pflanzenökologische Lichtmessungen. (Measuring the Intensity of Light). *Biologisches Zentralblatt*, Vol. 43, No. 4, pp. 404-431, figs. 10. Leipzig, 1923.

The author describes an apparatus for measuring the intensity of light. In his ecological work, he studies the intensity of sunlight and the temperature and moisture of the air, and also, light in forests, as well as direct and reflected light which are important for plant assimilation and respiration. D. v. S.

597. PRAT, S. (Institut pour la physiologie des plantes de l'Université Tchèque à Prague). Die Elektrolytaufnahme durch die Pflanze; die Resorption von Mineralstoffen durch die Wurzeln. (Electrolytes and the Absorption of Mineral Substances by Plant Roots). *Biochemische Zeitschrift*, Vol. 136, Nos. 4-6, pp. 366-376, figs. 2. Berlin, 1923.

Assimilation of mineral substances by plant roots. The absorption of electrolytes apparently depends very little on transpiration D. v. S.

598. SMIRNOW, A. I. (Laboratory of Agricultural Chemistry of the Agricultural Academy of Petrowskoje-Resumoskoje near Moscow). Über die Synthese der Säureamide in den Pflanzen bei Ernährung mit Ammoniak-salzen. *Biochemische Zeitschrift*, Vol. 137, Nos. 1-3, pp. 1-34, figs. 6. Berlin, 1923 (1).

The author studies the synthesis of amido-acids in plants supplied with ammoniacal salts. D. v. S.

599. FOLSOM, D. Mutations of the Potato. *Journal of Heredity*, Vol. XIV, No. 4, pp. 45-48, figs. 2. Washington, D. C., 1923.

Description of a simple-leaf sport of the Green Mountain variety of potato found in northeastern Maine in 1920. This sport in the third generation (consisting of a one-stalked plant), apparently reverted, partly to a compound leaf condition, two leaves being divided longitudinally, but its five tubers produced ten plants that were all simple-leaved. G. A.

(1) See also: PRIANISCHENIKOW, Über den Aufbau und Abbau des Asparagins in den Pflanzen. *Ber. Deutsch. Botan. Ges.* 40, 242, 1922. (Ed.)

CROPS IN TEMPERATE AND TROPICAL COUNTRIES

SYNTHETIC ARTICLES.

600. Cultivation and Fodder Value of Kudzu (*Pueraria Thunbergiana*).

I. — ARNOLD, H. C. (Agricultural Experiment Station, Salisbury), Propagation of Kudzu Vine *Bulletin* No. 429, *Department of Agriculture. Rhodesia*, pp. 1-4. Salisbury, 1922.

II. — McMARTIN, H. Kudzu. A remarkable Fodder Plant. A Queensland Farmer's Observations. *Queensland Agricultural Journal*, Vol. XVIII, Part 5, pp. 365-366 and pp 367-368. Brisbane, Nov. 1922.

III. — LEACH C. F. Beggar Weed and Kudzu Vine. *Rhodesia Agricultural Journal*, Vol. XIX, No 3, pp. 288-290. Salisbury, June 1922 reprinted from *Hoard's Dairymen*. Wisconsin, 1922, with foreword by the Editor of the *Rhodesia Journal*.

The value of kudzu (*Pueraria Thunbergiana*) as a forage crop has already been reported (1) but the increasing practical value has recently been confirmed in Rhodesia, Queensland and Wisconsin (U. S. A).

I. — As regards cultivation, very little attention is required but the propagation presents certain difficulties. H. C. ARNOLD has, therefore, described the methods found to be most successful in Rhodesia. Sowing *in situ* is not advised, except where special attention can be given to water supply and protection from leaf-eating insects. Transplanting from small tins has given more satisfactory results but care should be taken to keep soil and roots intact as kudzu seedlings are very easily damaged. Propagation by means of layers is practicable when the plant is once established, especially the unrooted slips system, planted direct in the permanent position and selected from near the parent root stock.

II. — The adaptability of kudzu to Queensland conditions has been proved during the past year. The plant has been tested under the most severe conditions of heat, drought and frost and the reports are excellent. The rapid growth and deep-rooting system are evident advantages. The benefit of propagation by layers is confirmed, and planting in damp soil is advised.

As regards value as stock feed, experiments in Queensland bear out the reports from the United States, namely that kudzu will furnish sufficient fodder (as much as 10 tons per acre) for 6 milch cows to the acre when grown on trellises 12 ft. apart. Tests have been made with sheep and lambs and results demonstrate the remarkable effect on ewes fed chiefly on kudzu and sweet potatoes. The improved quality of milk and the live weight of the lambs was noticed. One ram lamb 50 days old weighed

(1) See R. 1921, No. 151. (Ed).

53 lb. and a ewe lamb 54 lb.; kudzu is also apparently a very palatable fodder. A further point of interest lies in the fact that sheep which had become anaemic, recovered with unusual rapidity when thus fed.

III. — Reports by C. F. LEACH (U. S.) show that kudzu is recognised as a valuable forage crop in Florida (U. S.), for cows left on nothing but kudzu pasture for as long as 7 consecutive months (from April onwards) keep fat and sleek; an excellent winter roughage is also formed which is considered to be very nutritious.

This report has been utilised by the Department of Agriculture in Rhodesia to emphasise the value of this crop. Experience has already confirmed the high opinion formed of kudzu and its suitability to Rhodesia. If a legume can assist in solving the great problem of all the year succulent and nutritious grazing, it is deserving of being grown on every occupied farm and ranch and once its value is realised and proper attention given to propagation, it is considered probable that kudzu may do for Rhodesia on a limited scale, what lucerne has done for instance for the Argentine.

M. L. Y.

601. Cotton Growing in the Anglo-Egyptian Sudan and the Belgian Congo.

I. — Replies to Questionnaire, sent to the International Institute of Agriculture, by the Director of Agriculture, Khartoum, December 26, 1921.

II. — Annual reports of the British Cotton Growing Association for 1921 and 1922 (Manchester).

III. — Monthly Reports of the Commercial Intelligence Branch, Central Economic Board of the Sudan Government, January to July 1923, Khartoum.

IV HIMBURY, W. H., India and the Sudan as Sources for increasing our raw Cotton Supplies (*British Cotton Growing Association* p. 26 et seq.). Manchester, August 1923.

V. — The Cotton Growing Countries, Production and Trade, *International Institute of Agriculture*. Rome, 1922, p. 107, Anglo-Egyptian Sudan.

VI. — *Renseignements de l'Office Colonial du Ministère des Colonies de Belgique* December 1921 and June 1923. Brussels.

VII. — *Notes sur la culture du Coton au Congo Belge, Compagnie Congolaise*. October 1922, Brussels.

VIII. — "Congo". April 1923, pp. 608-610; June 1923, p. 142. Brussels 1923.

IX. — "The Cotton Growing Countries", International Institute of Agriculture, 1922. Belgian Congo, p. 87.

THE ANGLO-EGYPTIAN SUDAN.

I-V. — The Sudan includes the whole of the Upper Valleys of the Nile, with the exception of the equatorial lake region of the Protectorate of Uganda. The course of the Blue Nile from the Abyssinian frontier to its junction with the White Nile at Khartoum is in Sudanese territory.

The introduction of cotton as a commercial crop is quite recent, though native cultivation took place to some extent in earlier times, when the crop was devoted to domestic purposes. At present cotton is grown in many parts of the country, and is dependent for the necessary water supply on three main physical agencies. In the provinces of Berber and Dongola relatively small areas are utilized by means of pumping stations which draw water from the Nile. Along the course of the Blue Nile much larger works of the same description have been established or improved, and the area under cotton at Tayiba, Hosh and Barakat is now considerable. Near the shores of the Red Sea, the river Baraka comes down in flood from the mountain streams of Erythrea, and annually inundates a delta of varying extent in the Tokar district. The river Gash, originating also in Erythrea, forms year by year below Kassala a flood delta 50 miles in length, and afterwards disappears among the desert sands. The flooded areas vary greatly in extent, but the crops grown thereon frequently form a great proportion of the Sudan cotton yield.

Some plantations, partly experimental, occur in the Bhar-el-Ghazal and in the Kordofan provinces, where rainfall is usually sufficient for cotton growing.

Three methods of cultivation (Nile pumps, flood water, and rainfall) are therefore being followed at the present time.

The rainfall north of Khartoum is only about 3 inches (75 mm.) per annum, but south of Sennar (on the Blue Nile) it is about 20 inches (500 mm.) and in the Bahr-el-Ghazal about 40 inches (1000 mm.); and though swamps and sandy deserts are extensive, there is an immense territory available for cotton as well as for other crops.

The population of the Sudan was at one time estimated at 10 million, but the devastations of the Mahdi and the Khalifa reduced the number to about 2 million. With the present settled administration a good recovery has been made, a population of about 5 $\frac{1}{2}$ million being now recorded. Large areas formerly cultivated for food crops had consequently been abandoned, and in some instances cotton is now substituted.

The Tokar district (Red Sea Province), in spite of the variation in the area flooded annually by the river Baraka, presents the characteristics of a definite cotton-growing area, though limited in extent by the surrounding desert. Owing to the district's proximity to shipping facilities, transport difficulties are few, and, after the floods subside, the alluvial soil retains sufficient moisture to allow all the cotton to ripen in any season not specially unfavourable. Hot winds have occasionally caused growers to despair of their crops, and an instance is recorded where a year or two ago, a Greek family abandoned their cotton plantation and left the district. Some months later, a large advance in the price of cotton induced them to return to see what could be saved. They found an excellent and very profitable crop ready for picking.

The 1913 yield of lint in the Tokar district was about 1650 metric tons, and the greater portion was, as usual, of really good quality.

The other area of Sudanese cotton production dependent on inundation is situated at Kassala and in the delta of the river Gash, which is in



FIG. 101 — Hausas Picking Cotton at Kassali
(Photo by W. H. HUMBLY)



FIG. 102 — Transporting Seed Cotton by Camels from the fields
(Photo by W. H. HUMBLY)

flood during June, July and August ; the area placed under water varies from 80 000 acres to 200 000 acres (32 to 80 thousand hectares) between one season and another. The cotton produced is practically all of the Sakellaridis type. No rain falls later than October, though at Kassala during the inundation of the Gash, there are usually some 40 inches (1000 mm.) of rainfall. The alluvium has formed a soil bed of 10 to 12 feet (3 to 4 metres) in depth, and is composed of rich black clay. For the cotton crop it is sufficient to eradicate the quick growing weeds twice during the period of growth, and no other cultivation is done. If transport difficulties were not so great, much more cotton could be grown in the Kassala province. The whole of the cotton marketed has at present to be carried some 250 miles (400 kilometres) on camels to Suakin or to Port Sudan, and the supply of camels probably limits the available quantity to about 1000 tons in each season. A railway is in process of construction and when completed the conditions may be entirely altered.

The cultivators in Kassala Province and on the Blue Nile are an interesting race and are chiefly Hausas who emigrated from Nigeria. Being of the faith of Islam, these natives were in the habit of undertaking the pilgrimage to Mecca, and their caravans made the journey across Africa, passing through the Sudan on their way from Nigeria to the Arabian coast. The pilgrims were accustomed to halt in the Gash delta, sometimes to grow food crops, sometimes to aid in cotton-picking or in other work. They found the land so fertile and conditions of life so advantageous that they are settling in the Sudan in large numbers. Towns of 7000 or 8000 inhabitants have sprung up adjacent to the cotton lands of Kassala and along the Blue Nile. There is consequently no scarcity of labour. The 1923 crop in the Kassala province has been very satisfactory, yielding about 600 metric tons of lint.

Turning once more to the cotton-growing districts along the Blue Nile, the whole crop, estimated for 1923 at about 1800 tons of lint, is at present produced by irrigation from the pumping stations at Wad-el-Nau, Tayiba and others. The enterprise is under the auspices of the Sudan Plantation Syndicate, and is established on the following basis :

All the crops are pooled ; the Sudan Government has provided the land and has equipped the pumping stations, receiving in return 35 % of the gross proceeds of the crops produced. The growers receive 40 %, and the Sudan Plantation Syndicate retains the remaining 25 %. From this latter percentage all payments have to be made for the minor irrigation canals, first ploughings, ginning and storage and general expert supervision.

The primary aim of the Sudan Plantation Syndicate is not direct profit, but the encouragement of cotton production, since the Syndicate consists largely of cotton manufacturers.

About 20 000 acres (8000 hectares) of the Gezira plain are now under irrigation from this system of pumping stations ; of this about 10 000 acres (4000 hectares) bore cotton in 1923. The growers each hold, as tenants of the Syndicate, allotments ranging from 50 to 100 acres (20 to 40 hectares). All areas are applied for and occupied as soon as available.

A considerable proportion of the holders are Hausas, as in the Kassala district.

In the Sudan, planting begins as a rule in July, the chief exception being the Gash and Baraka deltas, where it is of necessity delayed until the subsidence of the June to August floods. In these two areas planting is carried on during September.

Picking starts in December, continuing until February in some of the rain-cultivation areas and in Berber and Dongola. On the Gezira plain, picking begins in February, as is the case too in the Gash Delta. At Tokar it is delayed until March, and in some seasons picking is not complete until June. The Commercial Intelligence Branch Report of May, 1923, contains the following statement relative to the Tokar (Red Sea) district: "Although large tracts in the Delta have ceased to yield; there are some considerable patches of late-sown cotton which should yield up to about 20 June".

From the above details it follows that cotton is mainly a winter crop in the Sudan, and differs from Egypt in that respect. It is also evident that cotton-growing in one or another part of this immense country is almost always in hand throughout the whole year.

The descriptions of cotton usually planted in the Sudan are the Sakellaridis, — so favourably known in Lower Egypt —, and the Achmouni, which is largely cultivated in Upper Egypt. Of the Sudanese crop grown in 1922, about 46 % was from Sakellaridis seed, and about 44 % of Achmouni origin.

Some localities have been found to suit American Upland varieties, and about 10 % of the 1922 crop was of this species. Where the American Upland plant has become acclimatized, the yield is greater than that of Sakellaridis, sometimes twice as large.

The pink boll-worm (*Platyedra* [*Pectinophora*, *Gelechia*] *gossypiella*) is, so far, unknown in the cotton plantations of the Sudan, and strict precautions are enforced against its introduction from Egypt, where it has been so very detrimental. The pest which has recently done serious injury in the Sudan is that known as *Thrips*, which destroys the vitality of the leaves and stalks, and was especially noticeable in the district of Hosh on the Blue Nile in the cotton crop of 1923. It was estimated that the yield has been reduced locally by 25 % from this cause. Aphides are occasionally present in great numbers, and "assal" was a cause of considerable anxiety at Tokar (Red Sea Province) during April, when cotton was coming to maturity continuously. The damage was, however, not serious as there was a return of favourable weather and consequent acceleration of ripening.

No statement as to cotton-growing in the Sudan would be complete without reference to the plans for future development. These plans conform in their origin entirely to the possibilities of water-supply. It is fortunate that engineering enterprise is available for coping with the many difficulties inherent in the undertakings. The main scheme is that of fertilizing a part of the Gezira plain by means of irrigation. This territory lies between the Blue and the White Nile, its surface forming an

immense triangle just to the South of Khartoum, with an area of about 3 million acres (1 200 000 hectares). To all appearance it is a level plain; in reality there is a slight slope from the eastward boundary by the Blue Nile, to the western limit on the White Nile, a fact rendering irrigation canals quite practicable by utilizing the Blue Nile stream. The Sudan Government, with the assent and guarantee of the British Government, has raised a large loan to meet the cost of a Blue Nile barrage at Makwar, a point situated above the existing pumping stations on the banks of the river mentioned. The barrage is well advanced in construction, and is expected to be complete in 1925. Subsidiary works of enormous extent include about 850 miles (1300 kilometres) of canals, including one main artery of 100 miles (160 kilometres) in length with a width of 20 feet (6 metres) and depth of 6 to 7 feet (2 metres). Mr. HIMBURY compares the whole scheme to the work of the Panama Canal. It will irrigate 100,000 acres (40,000 hectares) of land, and should be equal to greater activities, but the Egyptian Government is at present nervous about water-supply for the cotton crops of Egypt, and has requested the Sudan authorities to limit their drafts on the Blue Nile Stream to watering these 100,000 acres (40,000 hectares). Mr. HIMBURY mentions this as a "difficulty which is not without the possibility of solution by finding additional water elsewhere and at no very great capital expenditure for works". The completion of the Makwar barrage will result in superseding the pumping stations at Tayiba, Hosh and Wad-el-Nou, as, with the canal from the barrage, the whole irrigation system along the Blue Nile will be served without the present expenditure of power involved in pumping, during the low-Nile season, to an elevation of 50 to 70 feet (15 to 20 metres). Mr. HIMBURY remarks that these pumping stations have fulfilled an exceedingly useful purpose, as they have been the means of testing the capabilities of the land for production of good cotton under irrigation, between July and February, a period when the water is not required for Egypt. They have further assisted in training native growers in methods of cultivation, and Europeans in their duties of supervision.

The future development of the Gash Delta is dependent on the railway, which may be ready for transporting the cotton crop early in 1925. Within a short space of time this region might eventually produce 20,000 tons of lint, as some method of conserving flood water might be put into practice. The Kassala railway, too, will render accessible some new cotton areas, where water is equally plentiful; the mountain ranges of Abyssinia give rise to other rivers debouching into the plains.

Mr. HIMBURY has generously allowed the compiler of this article to quote freely from his Report to the Empire Cotton Growing Corporation on the capabilities of the Sudan, and has further placed at his disposal some interesting photographs.

Mr. HIMBURY's settled conviction is, that the Sudan has within its boundaries, the climate, the soil and the water to produce at no very distant date, a crop of cotton equal in quantity and quality to that grown in Egypt, which now produces about 220 000 tons annually.

THE BELGIAN CONGO.

VI-IX. — The districts where cotton is grown have been selected in conformity with climate and soil conditions, taking into account the density of population : cultivation is entirely a native industry and is located in the immediate vicinity of the villages. It thrives chiefly in the following districts :

a) Southward of the equator, in Sankuru and Kasai, Lomani, and Maniema.

b) North of the equator, on the Uélé river (upper and lower). The rainy season is completely different in a) and b) ; planting in the South takes place in December and January, in the North during June and July. Picking begins in the South in June and is completed by October ; in the North it lasts from December till April. Consequently cotton is growing throughout the whole year in the Belgian Congo. Agricultural inspectors act as seed distributors, select suitable ground for cropping, arrange dates of sowing, and advise the natives throughout the progress and picking of the crop. All seed for sowing is distributed or approved by the State authorities ; the destruction of all cotton plants after picking is over is strictly enjoined. The Government fixes minimum prices to be paid to natives. No purchases of cotton, except by machine ginneries, are permitted elsewhere than at the markets in localities and on dates fixed by the District Commissioner.

La Compagnie Cotonnière Congolaise was originated by the Belgian Colonial Ministry, and constituted in March 1920 with a capital subscribed by financiers and textile manufacturers in Belgium. The Colonial Government transferred to the company the two steam ginneries then under construction at Lusambo and Kibombo, and authorised the continuation of the cotton culture commenced by the State on an experimental basis in 1916.

The Company defined its aims as follows : a) Cotton buying, b) Cotton ginning, baling, forwarding and selling, c) Experimental work on new varieties of cotton, d) Production of pure cottonseed from the best selected varieties, e) Offering prizes to growers of the finest samples, f) The study of subsidiary industries, such as the manufacture of canvas for baling, and of cottonseed oil, g) Planting and cultivation of cotton and of other products included in the necessary rotation of crops or in food supply, also transport and shipment.

Five ginneries were in operation in 1922 and two additional establishments were to be installed. An oil press has been constructed at Lusambo.

In the district of Lomani, designated for installation of a ginnery, the cotton production in 1922 was only slightly larger than in 1921, as natives found palm oil more profitable. As there was no machine ginnery in the district the transport of the seed cotton (one-third lint, two-thirds seed) for long distances was very difficult and costly.

The data of production since 1917 are furnished by the Colonial Ministry at Brussels, the figures are in metric tons ; it is probable that those of 1920 and earlier represent unginned cotton, but those of 1921 and 1922

certainly give the quantity of lint remaining after ginning: 270—450—750—900—980—1055 metric tons for the years 1917-18-19-20-21-22, respectively. The management of an experiment farm in Maniema for the selection of cotton varieties on the most approved American plans, has been once more taken up by the State.

The cotton enemies include the pink bollworm, the bollworm or earworm, the cotton stainer and the cotton louse. No information is available as to the relative amount of damage done by these pests.

Exports, practically all to Belgium, were 986 metric tons of lint in 1922.

J. H. H.

602. **Kapok : Production and Commercial Value.**

I. — GRIST, D. H. Kapok. *Malayan Agricultural Journal*, Vol. X, No. 2, pp. 51-55. 1922, and *Idem*. Vol. XI, No. 1, pp. 1-27. Kuala Lumpur, 1923.

II. — EATON, B. J. and DENNETT, J. H. The Comparative Buoyancy of Malaya and Java Kapok. *Idem*, Vol. X, Nos. 10, 11, 12, pp. 295-300, Kuala Lumpur, 1922.

III. — GEORCHI, C. D. V. Kapok Oil. *Idem*, Vol. X, Nos. 11, 12, pp. 284-286. Kuala Lumpur, 1922.

IV. — MATHIEU, E. (Superintendent, Government Plantation, Kuala Kangsar), Kapok (*Eriodendron anfractuosum*). *The Tropical Agriculturist*, Vol. LIX, No. 6, pp. 335-343. Peradeniya, Ceylon, 1922.

V. — WALDOCK, A. P. Notes on Kapok. *Idem*, pp. 343-345. Peradeniya, 1922.

VI. — MOLAGODE, W. (Agricultural Instruction, Central Division). Kapok or Silk Cotton Tree. *Idem*, Vol. LX, No. 2, pp. 122-123. Peradeniya, 1923.

VII. — Indian Kapok Seed (*Bombax malabaricum*) as a Source of Oil. *Bulletin of the Imperial Institute*, Vol. XVIII, No. 3, pp. 335-337. London, 1920.

VIII. — Indian Kapok Seed and Kapok Fibres. *Idem* Vol. XX, No. 1, pp. 28-29 and pp. 31-32. London, 1922.

IX. — SALIEBY, M. M. The Kapok Industry, Revised Edition of *Bulletin* No. 26, *Bureau of Agriculture. Philippine Islands*, pp. 41, plates VIII, Manila, 1923.

X. — Kapok Industry of the Dutch East Indies. *Netherlands Indies Review*, Vol. 3, No. 7, p. 209. Buitenzorg, 1922 (1).

The Kapok tree (*Eriodendron anfractuosum*) is widely distributed throughout the tropics. The demand for kapok has increased considerably in recent years, and the undoubted value of the floss as filling

(1) Other bibliographical references to Kapok: *Netherlands Indies Review*, Vol. 3, No. 7, 1922 (Exports of Netherlands Oil from Java); *Report of Commerce, Industry and Agriculture in the Netherlands East Indies*, 1920; *Literary Digest*, May 6 1909 (Harvesting of Kapok in Java); *Nederlandsch-Indisch Landbouw-Syndicaat*. Soerabaja (Kapok Cultuur en Bereiding); *The Record of the Board of Commercial Department*, No. 8, pp. 17-21. Bangkok, 1923. (Kapok and possibilities in Siam).

for upholstery and life jackets, combined with the oil value is well known. Reliable information is now available from various sources which should assist the planter to obtain the full benefit from this crop, improve methods of cultivation, to clean and market the floss with comparatively little expense, and without waste and to ascertain further commercial advantages recently reported. Up till now statistics show that the largest supply comes from Java (1), the industry in the Dutch East Indies being well developed (X), Samarang fixes the recognised standards, as the chief exporting centre. The possibilities of extending the industry elsewhere appear extremely practicable.

Cultivation: Soil. — According to the reports from the Federated Malay States (I, IV) deep soil with sandy loam give the best results GRIST reports that in Java friable loam and weathered volcanic soil, well drained, is the most satisfactory and this is confirmed by SALIEBY (IX) who ranks alluvial soils after volcanic and reports satisfactory results in the Philippines (2), both on sandy and clay loams.

Climate. — Low elevations are preferable (IV and IX) and an altitude below 500 meters is advised (IX), sheltered when possible from strong gales, as the wood is brittle and the tree liable to suffer accordingly.

Propagation and planting. — The idea of growing kapok merely as a secondary crop has changed as this can only be done successfully with crops which do not demand thick shade or wind protection. In the Philippines (I, IX), good results have been obtained with sisal, maguey hennequin, Mauritius hemp.; in Malaya (I) with roselle, sunn hemp, limes and tobacco; in Java (I) with maguey. Interplanting with coconuts is not recommended but kapok may serve as a useful light shade for cacao and pepper (IV).

There has been a certain amount of controversy as regards the comparative advantages of reproduction by cuttings or seed. The general opinion seems to be that the former method is easier and yields sooner (6-12 months earlier) and is commonly employed in Ceylon. In the Philippines, and the Federated Malay States, the seed system, is, however, advisable as the plants are more resistant to wind and white ants. (I, IV, IX). GRIST (I) recommends the "seed to stake method" (3 seeds per hole, thinned to one), MATTHIEU (IV) considers that 9 inches apart *i. e.* 6 lb. per 100 acres is sufficient, SALIEBY (IX) advises shading until 12-15 inches high, some 20-25 days after germination, and transplanting after 10-12 months, early in the rainy season, leaving 20 ft., between: *i. e.* 112 trees per acre. Otherwise the branches are apt to die back owing to mutilation due to overlapping.

After treatment: Little after cultivation is necessary, but if other crops are not grown in conjunction with kapok, 4 ft. clean should be left round the plant during the early stages (I). In Malaya the young trees are treated like rubber *i. e.* topped, leaves stripped and roots trimmed. Co-

(1) The Bureau of Statistics (Int. Inst. of Agric.) reports the exports in 1921 as 17 585 339 kg. for Java, and 7 750 cwts for India (fiscal year 1921-22).

(2) For Kapok industry in the Philippines, see R. 1913, No. 1149. (Ed.)

pious maturing before lifting is important owing to scarcity of laterals. It is generally agreed that 18 ft. \times 18 ft. in suitable spacing, *i. e.* 132 trees per acre (I, IV).

Diseases and pests : White ants are the chief cause of damage ; reference has already been made to the greater resistance of plants propagated from seed in preference to cuttings ; keeping the plantations free from timber is also advised. Other pests include .

Dysdercus cingulatus, *Helopeltis* sp., *Batocera hector* and *Alcides lecuwenii* (I, IX). Diseases are not common, *Corticium salmonicola* and *Ramularia Enodendri* have been reported in Malaya (I). *Loranthus* spp. are the principal plant parasites

Harvest and yield. — The importance of gathering at the proper stage of ripeness is urged ; unripe pods will not dehisce if attempt is made first to dry in the sun as the floss adheres too much to the sides. This has been proved in Ceylon (IV). Experiments made in Malaya (IV) with mature and immature pods demonstrate the saving in cost of cleaning and extracting the capsules of the mature pods. When mature the shells become brown with deep wrinkles and begin to open below the peduncle. Extraction should be made at once or semi-pithy material becomes embedded in the final product (IV, V, IX) ; the proportion in weight, floss to seed is 3 : 5 (IV). It will probably be necessary to make 3 pickings.

The yield is forthcoming from the sixth or seventh year onwards with a gradual increase until about the 20th year (VI) The average crop per tree has been stated as 400 pods which equals 4 lb. clean floss per year -- and 1 acre of 109 trees will give about 440 lb. clean kapok (Ceylon reports VI) ; for 132 trees per acre, 528 lb. (Malaya reports I, IV) ; confirmed by Philippine reports (IX). Taken generally it may be stated that the yield of seed is double that of floss. The average composition of dry ripe pods is husks and placentas 44 %, seeds 35 % floss 21 % (I).

Cleaning and uses : The invention of cleaning machines is one of the most vital factors affecting the development of the kapok industry. Descriptions are given of the various hand methods employed in the different countries (I, IV, V, IX) The fact that these methods are only effective under close supervision indicates the importance of perfecting the machines. amongst the numerous machines which have made their appearance on the market, one has been reported to give an output of 800 to 1000 kilos of clean kapok per day (Henri JUMELLE) (IV). Various Dutch machines, simple in construction (0.5 to 1 H.P.), are capable of turning out 120 to 200 kilos of floss per day and amongst these, several authors have selected the *Bley* type as one of the best invented. It is claimed to clean about 217 kilos of floss per hour. A detailed description of this machine is given by the *Nederlandsch-Indisch Landbouw-Syndicat, Soerabaja*, « Kapok Culture are Bereiding ».

This machine (See I, IX) consist of a horizontal, cylindrical wooden drum with base made of $\frac{1}{2}$ inch mesh wire-netting, through which a square-section steel axle is fitted in self-lubricating bearing with a number of vanes or beaters set spirally on each face of the axle. These are fixed at an angle like the blades of a propeller and by imparting a screwing

motion, draw the kapok through the machine. The last pair of beaters, near the outlet, are set in opposite direction, to avoid choking. Opposite the outlet are two large fan-like blades set in the same plane as the axle which cause an air-blast and remove the cleaned kapok. Iron pins are driven into the sides of the drum.

The BLEY type has been in use on some Batavia estates for many years and appears the most reliable.

Other machines also described as useful are : the BECKER (cleans about 120 kilos of floss per hour (3 H P.) and the kapok requires no preliminary drying before treatment in the ginner ; the LIENAN small scale machine of simple construction, inexpensive to operate and useful for small plantations (cleans about 120-130 kilos per day of 10 hours (1 ½ H.P.) British manufacturers report that these machine are especially constructed to liberate the floss from the seed, the GAJAMPRI machine (vertical drum and axle filled with round, wrought-iron beaters; an air blast blows the cleaned kapok through a wide pipe at the top, and the heavy seeds fall through an opening in the bottom ; HK JONKER en ZOON's machine (Amsterdam), a more complicated construction, 4 H P., capacity about 600 kg. per day ; suitable for large quantities and produces a very fine silky kapok.

Marketing : The size of the bale varies according to the export market ; from Java to Europe the size is fixed at capacity 12 cub. ft. containing 90 lb. (IV). The kapok is baled in jute sacking for export to Australia and in matting for Europe. This is preferable to sacking, taking into account the nature of the floss Hydraulic baling is considered essential for export and the use of handscrew presses for inland transport ; the BLEY screw press has been found satisfactory (four sided chamber fitted with two screws one above and below) and also the side screw presses (I).

The Department of agriculture in Kuala Lumpur (F M S.) has made special investigations recently on cultivation machinery marketing, supply and demand, prices etc. (I).

Fibre value (1) : With reference to the recognised value as filling for upholstery, an interesting comparison has been made between the weight and costs of various forms of stuffing for an average mattress (I).

Kapok	9	kg. at 3.50 fcs. per kg.	31.50 fcs.
Seaweed	16	" " 0.75 " " "	12.00 "
Wool (white carded)	10	" " 3.15 " " "	31.50 "
Horse-hair	5.5	" " 5.15 " " "	43.07 "

Recent investigations have been made as to the comparative buoyancy of Malaya and Java kapok for life jackets (I. II) and results indicate that the Malayan samples are only slightly inferior to the latter and are well above the Board of Trade standard viz. — "a life jacket whose buoyancy is derived from kapok must be capable of supporting at least 20 lb. of

(1) WALDOCK (V) draws attention to a similar product, the value of which is not known, viz. the product of *Calotropis gigantea* and *C. procera*. This shrubs grows wild in Ceylon and gives a silky and long staple fibre which probably has a distinct commercial value.

iron after floating in water for 24 hrs with a 15 lb. iron weight attached". As regards suitability for spinning purposes, various tests have been made in Germany etc and reports have been received from the Director of Economic Services in Indo-China concerning the native industry. It appears that the fabric is unsuited for making garments but is of considerable value for linings of overcoats.

The value as a filler for surgical dressing has hitherto not been fully appreciated (1), for this purpose it possesses the requisite advantages of lightness, elasticity, dryness and adaptability to dry sterilisation.

Oil value. (III). — Experiments made in Malaya show that Kapok seed constitutes a valuable by-product containing rather more than 20 % of oil, easily extracted and decorticated in which case the oil content of the kernel amounts to about 40 %; the cake is rich in albuminoids, 4 % nitrogen corresponding to 25 % albuminoids.

The Indian Kapok (Bombax malabaricum) (VII, VIII) (2) — This species is found throughout India and Ceylon. Unlike the *Eriodendron* the floss surrounds the seeds in the capsule and in preparation for market the seeds are separated. Investigations have been made at the Imperial Institute (London) to ascertain the commercial value of the fibre and oil. Analyses indicate that compared with the ordinary kapok, the yield of oil is higher and the quality superior, the constants of the two types are similar but the iodine value of the oil of *B. malabaricum* is considerably lower. The residual meal was of more value as a feeding stuff and has a higher nutritive value than undecorticated cotton seed cake.—

	Moisture	Crude protein	Fat	Carbo- hydrate	Fibre	Ash	Nutrient Ratio	Food Units
	%	%	%	%	%	%		
<i>E. asfractuosum</i>	13.80	26.25	7.47	23.10	23.19	6.10	1.15	197
<i>B. malabaricum</i>	11.40	36.50	0.80	24.70	19.90	6.70	1.07	118
Undecorticated Cotton seed cake	12.75	24.62	6.56	29.28	21.19	4.60	1.167	107

It is considered likely that Indian Kapok seed will fetch a price equal to if not higher than that realised by commercial kapok seed viz £15 per ton in November 1920 on the British market.

Investigation as to the suitability of machine-cleaned Indian kapok for use in life jackets have been in progress (1916-1922), and official tests of floss have given satisfactory results.

M. L. Y.

(1) See R. 1919 No. 520. (Ed.)

(2) Another *Bombax* sp. namely *B. buonopozense* var. *Willemsii*, of probable value has been found in the Sudan. See R. 1920, No. 422. (Ed.)

603. **Coimbatore Sugarcane Seedlings.**

I Review of Sugar Cane Agricultural Operations in India, 1921-1922. *The International Sugar Journal*, Vol XXV, No 293, pp 242-246, London, 1923

II The Exotic Value of Coimbatore Seedlings *Ibidem*, No 294, pp 284-285.

III CLARKE G, HUSSAIN, MOHD, NAIB, and BANNERJEE, S C Coimbatore Sugarcane Seedlings in the United Provinces *Agricultural Journal of India*, Vol XVII, No 5, pp 445-462, Calcutta, 1922.

IV Mill Trials of Selected Coimbatore Sugarcane Seedlings. *Ibidem*, Vol XVIII, No 3, pp 249-256, Calcutta, 1923

The problem of the improvement of the Indian sugar industry is mainly one of increasing the tonnage of cane per acre, as the yield in Hawaii is about 41 tons, Java 40, Cuba 20 and in Northern India only 11 tons per acre. Cane varieties suitable for this district must be very hardy as the cultivator of North India gives his cane indifferent treatment and rarely has capital to expend on fertilisers

In 1912 the Cane-breeding Station at Coimbatore was sanctioned and the problem of evolving a better type of cane was undertaken by Dr. C. A. BARBER, C. I. E. late Imperial Sugar Cane Expert, whose work is now being continued by his successor, RAO SAHIB T. S. VEN KATRAMAN. The methods in breeding and raising the seedlings are given in detail with excellent illustrations in *Memoirs of the Department of India* (1). It was necessary to supplant the present type of cane by an equally hardy type, but with better juice, shorter growing period and yielding a greater tonnage of cane. An interesting point in the breeding was the introduction of the wild grass *Saccharum*, which was crossed with a tropical cane acclimatised for a century or more in Southern India. After several years' work seedlings were produced having the required characteristics, and these have been practically tested under North Indian conditions at the Shahjahan Sugar Station. These new seedlings are resistant, early maturing and give a large yield of canes with rich juice

Seedling No. 205 gave 60-80 % higher yield of *gur* per acre than the best local canes in the Punjab but Nos. 210, 213 and 214 are considered to be the most promising. At Pusa No. 213 gave 60 tons per acre of good quality cane and 214 has been selected for extended trial in the United Provinces

The first mill trial was carried out in December 1922 when over 9 tons of No. 214 were crushed; the results obtained were as under:

This cane (214) ripens much earlier than Hemja and apart from the increased tonnage which it gives, actually yielded 1.5 % more sugar. RAO SAHIB VEN KATRAMAN states that more recent seedlings now undergoing trials are superior in all respects to those already sent out.

(1) *Memoirs of the Department of Agriculture of India*, Pusa Studies in Indian Sugarcane, by C. A. BARBER, C. I. E. Sc D. Vol VII, No. 1, 1915; Vol VIII, No 3, 1916, Vol. IX, No 4, 1918; Vol X, No 2 and No 3, 1919.

Comparative analysis of the first mill juice.

	Co 214 crushed December 6	Hemja (local variety) crushed December 7
Brix	19 30	16.70
Sucrose	15 94	13 54
Purity	82 58	81.08

These new Coimbatore seedling canes should be worth the attention of countries outside the tropics, such as Natal, Southern Queensland and of New South Wales, or even Egypt and Argentina. W. S. G.

604. **Nicotine Content of South African Tobacco (1) and the Value of *Nicotiana rustica*.**

I — JURITZ, C F, The Nicotine Content of South African Tobacco *Journal of the Department of Agriculture, Union of South Africa*, Vol IV, No 6, pp 552-562, bibliography Pretoria, 1922

II — Production of Tobacco suitable for Manufacture of Nicotine *Idem Annual Report of the Department of Agriculture Idem*, Vol V, No 6, p 503 Pretoria, 1922

III - OOSTHUIZEN du P (Manager Experiment Station, Rustenburg). Tobacco Cultivation for Nicotine *Nicotiana rustica* Species *Idem*, Vol VI, No 2, pp 166-175 Pretoria, 1923

Investigations have been made recently with the heavier and lighter South African tobaccos to ascertain the available percentage of nicotine content. Samples have been collected of various species and from different localities and analytical tests made at the Potchefstroom School of Agriculture in conjunction with cultural experiments at the Rustenburg and Elsenburg Experiment Stations.

The most promising results were obtained with a wild variety *Nicotiana rustica*. The nicotine content was 8.87 % (leaves) and 6.24 % (whole plant) compared with 3 to 5 % of other heavy tobaccos. According to the analyses made by Dr JURITZ, there is a distinct variation in nicotine content at different stages of growth. There appears to be an increase up to a certain stage and a subsequent diminution as the plant matures. Results compare very favourably with other wild species such as *Nicotiana glauca* (0.18 % nicotine from fresh leaves) and with the ordinary tobacco, *N. Tabacum* (4 %). OOSTHUIZEN reports that *N. rustica* has proved less susceptible to insect pests and diseases and is hardier and earlier than the ordinary species. The actual cultural operations are almost identical. A heavy application of farmyard manure and other nitrogenous fertilisers increases both yield and nicotine content. Close planting (12 inches apart in the row) is more effective than 18 inches; a difference of approximately

(1) See R. 1922, No. 1313. (Ed.)

400 lb. per acre has been obtained at Rustenburg although the nicotine content is identical. Topping the plants appears, however, to have an advantageous effect in this respect and also facilitates the harvesting of the plants when most of the leaves are matured. At present the utilisation of the whole plant appears to be the most economical proceeding as the stalk gives about 2 % nicotine. From two to three cuttings can be made in one season if the crop is not allowed to become over ripe.

Green sweating in a cool shed followed by air curing has given the best results from the economic standpoint, although a flue-cured leaf contains the highest percentage of nicotine. The percentage is lower when the whole plant is air-cured than when individual leaves are air-cured. Drying tobacco in the sun considerably reduces the nicotine content.

OOSTHUIZEN reports the results obtained with different manurial treatments and the effect of cutting back and leaving untopped, and the tables show the moisture, nicotine and ash content of the component parts of the plant.

Results of the Experiments at Elsenburg and Rustenburg should encourage the growing of this species of tobacco and it is considered probable that the manufacture of nicotine in South Africa will develop into a profitable undertaking (1).

M. L. Y

Crops.

605. The Quality of Selected and Hybrid Swedish Wheats.

ÅKERMAN Å. Försök och iakttagelser rörande svenska vetesorters Kvabtet. *Tidskrift för Landtman*, No 13, p. 201-203. Stockholm, 1922.

The object of the selection work begun in 1880 by the Seed Society at Svalöf and its branches was to unite in one type of autumn wheat, in the best possible proportions, the characters of productiveness, strong straw and cold resistance.

The question of the quality of the product was for a long time regarded as being of secondary importance. It is only quite recently, as a result of the special condition of the market induced by the war, and the great increase of grain production in Sweden, that the attention of expert breeders of selected seed has been seriously directed to the improvement of the grain.

Before, however, actual true selection in this direction can be undertaken, it is necessary to determine the real differences between the selected types and the native types and study the nature of these differences in order to obtain some data that will guide the selectionist in his choice of the best methods of surely and rapidly attaining his objects.

(1) Experiments have been made at the Federal Experiment Station, Ephrata, Philadelphia (U. S. A.) with *N. rustica* which confirm the nicotine value of this tobacco; and claim also that the product is very suitable for destruction of insect pests. The dried leaves and stalks are ground to a fine powder and 1 lb. of the powder is sufficient to make 20 gallons of 5 % solution. (*Florists Exchange*, Pa.). (Ed.)

The first difference noticed on comparing Canadian Red Fife wheat with Swedish Pansar is that of the water content, which amounts, respectively to 11-13 % and 15-19 %. Before the grain is ground at the mill, it is first soaked, and then dried till it contains 16 % of water. It can be readily understood that the American wheat with an average water content of 12 % can quickly increase it by 4 %, thus giving a yield 5 % higher than that of the Swedish wheat with an average water content of 17 %.

The great virtue of imported hard wheats is their capacity to absorb and retain a larger amount of water which renders the bread more porous, bulky, and digestible while at the same time improving its appearance.

This property, however, is more advantageous to the baker than to the consumer, who when he buys bread made from American wheat, obtains for equal weight many less calories than from bread made from Swedish wheat. The present mixture which is composed of Swedish flour to which has been added 30 % of flour made from hard wheat seems to satisfy the requirements of bread-making. This mixture absorbs a little less water than pure American flour, gives 450-490 cc. of bread per 100 gm. of flour, and bakes easily and well.

According to the author, the wheat produced in Sweden should contain about 15 % of water. (Pansar 17 %).

We will now examine in detail the qualitative characters of both the old local types and of the selected types and the hybrids. The following table gives a summary of RHODINS observations (1910-1913).

Thus, the native Swedish wheat ranks first, both as regards volume of bread and gluten content. It is closely followed in volume by Bore, Grenadier II and Sol which varieties have, however, a slightly lower gluten content.

In 1920 and 1921, the author carried out a series of bread-making

	Weight per hectolitre		Gluten content		Flour yield		Volume of bread in cc per 100 gm of flour	
	1910	1913	1910	1913	1910	1913	1910	1913
	kg.	kg.	%	%	%	%		
Renodlad Squarehead	77.6	78.4	12.0	10.6	77.6	77.2	459	452
Extra Squarehead	76.6	76.9	14.5	11.2	77.5	75.4	485	(323)
Grenadier II	78.1	77.6	13.0	9.4	76.8	76.8	(541)	457
Bore	78.6	77.6	14.1	10.9	78.8	75.8	498	481
Pudel	77.0	77.0	14.0	10.9	75.0	76.3	445	443
Sol	79	81.5	13.1	11.0	77.9	78.2	468	463
Landvete (native)	78.5	80.4	14.9	13.4	78.0	77.8	506	458

tests with the chief varieties of wheat on the market in the United States, and from the Svalöf Station, and the Sub-Stations of Ostergötland, Uppland, Värmland and Angermanland. The results of these experiments showed that Bore and Thule II were very near native Swedish wheat from the

standpoint of volume Taking the volume of the latter as 100, we have 98.7 and 97.7 for Bore and Thule respectively. The dough of Bore and Thule is a little less elastic and the bread somewhat less porous than in case of the local native Swedish wheat.

Thule II comes from a cross between Pudel and Sammet (native Swedish), and has inherited the good bread-making qualities of the latter. From the same cross has been obtained the Svea type which is especially suited to the northern districts of Svealand owing to its resistance to cold, and weight per hectolitre. Its bread-making qualities were not satisfactory, so that if the results of the tests are confirmed, it will be necessary to replace this variety with another. This work is, indeed, already in progress at the Sub-Station of Ultuna.

The Birgitta wheat also makes bad bread, its vegetative characters are probably derived from Smaahvede.

The most widely-grown varieties of south Sweden, Pansar II and Sol II, are inferior to Bore and Thule. Reckoning the volume of native bread at 100, we have 94.3 and 96.8 for Pansar and Sol respectively. Excellent results have, on the other hand, been obtained from the Halland March wheat and Extra-Kolben March-wheat. At the present time, the different wheats rank as follows:

- 1) Squarehead and Smaahvede
- 2) Sol and Pansar
- 3) Thule and Bore.
- 4) Native Swedish.
- 5) Group of March-wheats, Kolben type, etc

The best quality of hard American wheat gives a volume of bread 10 % larger than that of the native Swedish varieties. In the case of Thule and Bore, however, it is necessary, in order to obtain flour of this strength, to add only 15-20 %, instead of 30 % of American grain, on the other hand, 30 % must be added to Sol and 30-40 % to Pansar.

It is very advisable that the work of crossing and selection already begun at Svalof should be continued with a view to improving the types obtained, especially as regards the requirements of South Sweden.

G. A.

606 **Red Fife Wheat.**

Report issued by the Incorporated National Associations of British and Irish Millers. London Corn Circular, Year 80, No 75, pp 5-6. London, 1923.

The varieties of wheat grown in England, with the exception of the new one, Yeoman, are not suitable for the commercial production of bread without the addition of imported wheat. If home-grown varieties can be produced that are satisfactory to the farmer, miller and baker, the prospects of wheat-growing in England may be revolutionised.

Red Fife wheat, imported in 1902 from Canada and grown successfully during the past 21 years, yields flour of excellent quality, and has been used by Prof. BIFFEN in the evolution of new varieties.

The appearance of a wheat is not a correct index of its quality, nor is the percentage of dry gluten a correct index of a flour's strength, as

determined by baking trials. By the term "strength" is implied the capacity of a flour to yield large, shapely loaves.

The principal conclusion drawn by Messrs. A. E. HUMPHRIES and R. HUTCHINSON from a series of tests made on Red Fife wheat grown at eleven different places in England are —

a) That after 21 years of continuous production in England Red Fife retains its distinguishing characteristics.

b) When grown in some environments its strength, judged by appearance, seems to have diminished, but baking tests show that even in those cases, it retains its distinctive characteristics.

c) That whereas flour from ordinary English wheat cannot be subjected to long processes of baking, the Red Fife grown for 21 years in England, behaves in this respect quite as satisfactorily as No. 1 Northern Manitoba

d) That its characteristics are not substantially affected even if the wheat contains soon, after harvest, from 18 to 21 % of water, but remains free from sprouted grains.

e) The differences in gluten content are not correlated to the differences in the volume of the loaf

f) That Red Fife almost invariably yields in panary fermentation an insufficient quantity of gas, unless some form of yeast food is used.

W. S. G.

107 Experiments on the Green Manuring of Rice (1).

SOMERS TAYLOR, C (Agricultural Chemist, Government of Bihar and Orissa) and GHOSI, M (Professor of Chemistry and Physics, Sabour Agricultural College) *Agricultural Journal of India*, Vol XVIII, Pt II, pp 104-114, tables 6 Calcutta and London 1923

A series of experiments were made at the Sabour Agricultural College to ascertain the value of phosphatic fertilisers combined with green manure for paddy. The following scheme was adopted based on the successful results obtained by the use of superphosphate on the leguminous crop grow. 1) Control, 2) green manure only, 3) green-manure and apatite 3-9 maunds per acre (1 md = 82 lb.), 4) green manure and superphosphate, about 2 cwt 20 lb. per acre, 5) superphosphate at same rate; half applied at time of sowing the green crop and half at time of puddling soil for transplantation of paddy, 6) basic superphosphate, same rate and treatment; 7) superphosphate alone; 8) basic superphosphate alone.

The results demonstrate clearly that there is no economic advantage in the use of phosphatic manures alone but that applied in conjunction with green manure, marked results were obtained. Working on this basis, further experiments are reported 1919-22 showing the increase in weight of the valuable green crop "dhaincha" (*Sesbania aculeata*) as a result of this combined treatment. For example, green manure only — weight in lb. per acre, 1040; + 1 cwt. bone meal, 4575 lb. + 3 cwt. +

(1) See R. April 1921, No 383. (Ed)

super 6862 lb. Experiments made in other districts confirmed these results. The paddy is transplanted when about 2-6 inches high and should give a yield of about 2-3 tons per acre.

These experiments refer to poor sandy soil containing only 0.036 % total phosphoric acid and 0.44 % lime.

In consideration of the recognised function of the leguminous crop, to supply nitrogen, further experiments were made to ascertain the actual amount of nitrogen which it is possible to supply to sand by the use of the green manure *Sesbania aculeata*. Plants were grown in sterile nitrogen-free sand and determinations were made at different stages of growth. Results showed that in 17 days, the quantity of nitrogen fixed per plant was 3 times that contained in the seed and in 50 days this was about 150-200 times higher. Estimating 1 plant per foot square and 43 560 plants per acre, the amount of nitrogen added to the soil by *S. aculeata* would be: for 0-20 days, 196 gm.; for 40-50 days, 2 702 gm.; for 50-60 days 7654 gm.; for 60-70 days, 13 434 gm.; for 70-80 days, 21 862 gm. With, a 6-inch spacing, from plants 50-60 days old, it is estimated that 177 664 gm. of dry matter or 588 320 gm. green matter and 30 616 gm. of nitrogen may be obtained per acre. The vigour of the plants and the rapidity of growth also determine the amount of nitrogen fixed, the greatest amount fixed per unit of dry matter was at the ages between 6 to 8 weeks. The percentage of nitrogen in the plants appeared to increase with age, at 50-60 days, 0.039 gm. per plant; at 60-70 days, 1.80 gm. The amount of dry matter remained nearly constant at 11-12 % of the total green weight until the plants were about 50 days old, this was followed by a sudden rise and then remained stationary at nearly 25 % until the flowering period.

M. L. Y.

608. The Effect of Root Excretion of common Paddy Weeds upon Crop Production of Lowland Rice.

DE PERALTA F and ESTIOKO P R *The Philippine Agriculturist*, Vol XI, No. 7, pp. 205-210, tables 3, bibliography Los Baños (Laguna), 1923

Experiments were made by the authors in 1922 at the College of Agriculture, Los Baños (Laguna) with a view to substantiate the theory hitherto put forward *i. e.* that the main cause of low yields obtained through inadequate crop rotation may be attributed to the excreta of growing roots, when the aqueous extract of soil from fields where certain weeds are abundant, is applied to another crop. A lowland variety of rice was selected for study and cultures of common weeds in paddy fields, zacate (*Leersia hexandra*), water lily (*Monochoria hastata*), sedges (*Cyperus* sp.) and rice (*Oryza sativa*) were prepared as follows—

The water from the upper set of cultures (weeds) made in quadruplicate form in 5 sets of cans, is directed into a lower set of cans containing rice cultures. Each can contains 18 kg. of well pulverised clay loam.

The results obtained show conclusively that *Cyperus* spp. and water lily excrete substances beneficial to rice production and zacate excretions have a detrimental effect.

If therefore, these two common paddy weeds are grown in rotation with rice, an increase in production may be expected; and the contrary applies to zacate. It appears also that rice excretes a deleterious substance causing a reduction of 9% in grain yield replanted in the same field. The authors consequently recommend thorough ploughing and harrowing before planting to ensure elimination of the toxic substances.

M. L. Y.

609 **The Effect of Potassium and Magnesium upon the Quantity and Quality of the Potato Crop.**

MARHOLT, D. Untersuchungen über die Wirkung des Kaliums und des Magnesium auf Menge und Güte der Kartoffelerträge. *Die Landwirtschaftlichen Versuchsstationen*, Vol. C, Part 6, pp. 315-340, bibliography. Berlin, 1923.

The author gives a summary of the literature (dating from the time of Liebig), that deals with the effect of magnesium upon plants, and then passes on to describe his own experiments made during the three-year period 1917-1919, in the field belonging to the Chemical Laboratory of Giessen (Germany), on an alluvial clay of great water retaining capacity. The objects of the experiments were to determine how far the quantity and quality of the crop were influenced by 1) various magnesian salts, 2) the separate introduction of the chloride, sulphate and carbonate of magnesium into a complete fertiliser, 3) the application of the salts combined with green manuring such as hop clover (*Trifolium procumbens*). 2), fertilisers like those mentioned in 2 and 3 supplemented with stable-manure.

The mineral fertiliser was composed of sulphate of ammonia (60 kg. nitrogen per hectare), basic slag (110 kg. of phosphoric acid per hectare), potassic and magnesian salts (100 kg. of oxide of potassium, or magnesium, per hectare). The stable manure was applied at the rate of about 400 quintals per hectare.

The results obtained show that:

1) The salts of magnesium present in the soil have no favourable effect upon potatoes, the salts containing chloride of magnesium decrease, as compared with a complete fertiliser, the starch content of the tubers.

2) In fertilisers that do not include substances forming humus, magnesian salts have very little effect upon the potato crop. In many cases, the application of sulphate of potassium alone produces as large, or almost as large crops as are obtained with potassic salts + magnesian salts. Sulphate of magnesium sometimes increases the yield; the carbonate and chloride are both less effectual.

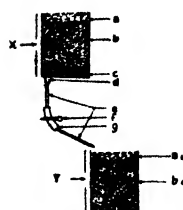


FIG. 103 Showing method of obtaining the drainage from Cau cultures

- x - Upper culture (weeds)
- y - Lower culture (rice)
- a - water
- b - soil
- c - gravel
- d - rubber stopper
- e - glass tube
- f - pinch cock
- g - rubber tube

3) The effect of a complete mineral fertiliser is greatly increased by the addition of organic manure. Green-manuring with hop clover considerably intensifies the favourable effect of a potassic-magnesian fertiliser, when the latter is applied in the form of a sulphate. The absolute starch yield generally increases with the potato crop, but the starch content of the tubers is decreased by the green manure, especially if this is applied at the same time as a complete mineral fertiliser (nitrogen, potassium, sulphur). The percentage of starch in the potatoes is, on the other hand, slightly increased if sulphate of magnesium is also introduced. This percentage was 21.06 in the unfertilised plots; 19.52 in those receiving only green manure, 18.80 in plots with green manure + nitrogen + potassium (sulphate); 19.12 in plots with green manure + nitrogen + phosphorus + sulphate of potassium and of magnesium. On the other hand, the absolute amounts of starch in quintals per hectare were respectively 6.76 — 7.10 — 33.22 — 35.04, and the yield of tubers was respectively 32.1 — 36.38 — 176.70 — 183.28 quintals per hectare.

4) The application of stable-manure increases the good effects of mineral fertiliser still more than green-manure. A complete mineral fertiliser added to stable-manure produces a crop of tubers 20 to 40 % higher than can be obtained when green manure is added to the organic manure, and 50 % higher if it includes the sulphates of potassium and magnesium. The effect of stable-manure upon the starch content of the tubers is similar to that of green manure.

The use of sulphate of magnesium as a fertiliser for potatoes is only to be advised when it is added to stable-manure applied at the same time as a complete mineral fertiliser.

F. D.

610. The Cultivation of the Sweet Potato in Java.

CRAMER, P P S (Director of the General Station and of the Experiments Station of the Department of Agriculture at Buitenzorg, Java) *Revue de Botanique appliquee et d'Agriculture Coloniale*, Year 3, Bulletin No 20, pp 233-241 Paris, 1923

In the Dutch Indies, the sweet potato (*Ipomoea Batatas* Poir), occupies the fourth place in the series of food crops, the other three being rice, maize and manioc. The sweet potato is chiefly grown in Java as a dry season crop; it occupied 179 000 hectares in 1916, and 267 000 hectares in 1920.

The following is the composition of the tubers as grown in Java: water 70 to 86 %; starch 8.22 % glucose 1.5 to 4 %. Most of the crop is used for human consumption, while a certain amount is fed to pigs. Formerly, sweet-potatoes were grown on the rubber plantations, but this practice had the disadvantage of attracting wild boars. As the tubers can produce 3250 to 3860 kg. of starch per hectare in four months, the sweet potato forms a cheaper source of starch than manioc, a plant that occupies the ground for a much longer time. Sweet-potatoes are planted on loose soil in a well-prepared bed. Generally, 36 000 are planted per hectare. All that is necessary is to hoe them once, or twice, and keep the bed in good condition

The plants are propagated from the stems, the upper portions cut into pieces, one foot in length being used by preference. In America, rooted slips obtained by putting the tubers on a layer of sand under a frame are chiefly used in order to shorten the vegetative period. Shoots develop from the eyes and are pulled out of the soil, the tuber being held in its place during this process. This method is to be recommended for introducing new varieties

An average crop of 12 000 kg. per hectare removes from the soil 35 kg. nitrogen, 14.5 kg. phosphoric acid and 72 kg. of potash. Experiments made in Java have shown that sulphate of ammonia is especially effective in increasing the yield, potash appeared to have no fertilising power. The introduction of a green manure into the rotation seems to be the best method of fertilising. Great care must be taken in the application of a fertiliser, for an excessive supply of nutritive substances may cause the plant to develop stems and leaves at the expense of the tubers. Thus, at Buitenzorg, the "Oebi Krantil" variety produced on the less fertile parts of the rice-fields 25 200 kg. of stems and leaves and 8400 kg. of tubers, while on the richer plots, it bore 54 600 kg. stems and leaves and only 900 kg. of tubers. In the case of the "Onglay" variety, the figures were respectively 16 200 kg. (leaves and stems) and 14 200 kg. (tubers) on the one hand, and 44 800 kg. and 5 500 kg. on the other.

The crop is lifted 4 months after planting. M. VAN SETTFN has observed the following progression in the yields (Tjina variety) — 3 months: 1 200 kg., 4 months, 14 700 kg.; 5 months, 16 800 kg.; 6 months: 10 800 kg. The tubers when taken out of the ground must be dried in the sun and carefully handled. The only enemy of the sweet potato is a beetle, *Cylas turcipennis* (known in other countries as *C. formicarius*). The sole means of combating this pest is by a rotation of crops, rice, being the best for the purpose, and by not leaving the tubers long in the ground.

The net cost of sweet potatoes is 1.60 dollar per 100 kg. in the United States, but in Java, the native grown crops can be produced for less than half this amount. The sale-prices in the two countries are in the same proportion. The different varieties of the sweet potato vary greatly in flavour owing to the fact that in Java these tubers are never eaten by the white man, whereas in United States, they are even more appreciated than the ordinary potato. The Division for the Selection of Annual Plants at Buitenzorg, under the Management of M. Kock, has produced a number of new kinds of sweet-potato which are supplied on application

R. D.

611. Seed Mixtures for Grasslands.

STAPLEDON, R. G. (Welsh Plant Breeding Station, Aberystwyth). *Journal of the Ministry of Agriculture*, Vol. XXX, No. 2, pp. 130-142. London, May 1923.

The author draws attention to the economic importance of selection of strain rather than depending only on species. This applies especially to white clover; the commercial Dutch should only be used on grassland

reserved for two years for sheep grazing but wild white clover can be substituted on short duration grassland as it tends rapidly to form a dense sward. The respective values of early and late red clovers, and imported cocksfoot are also indicated.

As regards the question of *complex* or *simple* seed mixtures, the author refers to three distinct objections to the former, viz. too much competition between the species, unsuitability of certain included species to particular conditions, and different requirements for germination. This points to the necessity for careful choice of mixtures.

Seed mixtures may be classified as follows: *a*) Stubble; *b*) one-year ley; *c*) two-year ley; *d*) three-year or upwards including permanent pasture.

Insufficient use is often made of stubbles. In Wales a plan has been adopted of sowing seeds with the cereals, solely for the purpose of providing autumn and winter keep until ploughing is begun. Quick growing red clover and Italian rye grass (1) have given the best results (13 lb. per acre is recommended, sown directly after the cereal and harrowed in at the same time).

The following standard mixtures give an idea of the seeding rates which are generally adopted:

One-Year ley: *a*) for every heavy single hay crop:-- Perennial rye grass (2) 14 lb. + late flowering red-clover 4 to 6 lb. + alsike clover (3) 1 to 2 lb.; *b*) for stubble grazing and aftermath as for hay -- Italian rye grass, 14 lb. + broad red clover 4-6 lb. + alsike, 1-2 lb.; *c*) general purposes -- Italian rye grass 6 lb. + perennial rye grass 10 lb. + late flowering red clover 2-3 lb. + broad red clover 2-3 lb. + alsike, 1 lb.; *d*) for conditions unfavourable to the rye grasses but very favourable to timothy grass: timothy 10 lb. + alsike 6 lb. or timothy 10 lb. + late flowering red clover 4 lb. + alsike 2 lb.

Two-Year ley: *a*) for soils where perennial rye grass is known to hold well into the second year: perennial rye grass 14 lb. + late flowering red clover 4-6 lb. + alsike, 1-2 lb. + wild white clover $\frac{1}{4}$ to $\frac{1}{2}$ lb.; *b*) for soils where cocksfoot contributes in the second year to a larger extent than the perennial rye grass: cocksfoot (4) 10 lb. + timothy 4 lb. + late flowering red clover 4-6 lb. + alsike 1-2 lb. + wild white clover $\frac{1}{4}$ to $\frac{1}{2}$ lb. or in proportions of 8 lb. + 8 lb. + 3 lb. + 4-6 lb. + 1-2 lb. + $\frac{1}{4}$ to $\frac{1}{2}$ lb. respectively; *c*) for soils especially adapted to timothy: timothy 10-12 lb. + alsike 4-4 lb. + wild white clover $\frac{1}{4}$ to $\frac{1}{2}$ lb. (As timothy flowers so much later than other grasses, a combination of rye grass is not here recommended). The above mixture is an exceptionally cheap one; *d*) where it is necessary to rely chiefly on tall oat grass: Tall oat grass 16 lb. + late flowering red clover 4 lb. + alsike 1-2 lb. + wild white clover $\frac{1}{4}$ to $\frac{1}{2}$ lb., or the same mixture, but with 8 lb. perennial rye grass and 8 lb. tall oat grass.

(1) *Lolium italicum*.

(2) *Lolium perenne*.

(3) *Trifolium hybridum*.

(4) *Dactylis glomerata*. (Ed)

Long duration leys and permanent grass: — a) *for hay and pasture*: — a simple mixture for a three-year old ley is given as follows: perennial rye grass 16 lb. + cocksfoot (New Zealand) 10 lb. + timothy (Scotch), 4 lb. + late flowering red clover 4 lb. + trefoil 1 lb. + wild white clover 1 ½ lb. Where, however, trefoil is not forthcoming (under conditions of high rainfall and on now calcareous soils) the following is considered a "sensible mixture": — perennial rye grass 12 lb. + cocksfoot (New Zealand) 8 lb. + timothy 4 lb. + late flowering red clover (Welsh) 4 lb. + alsike 1-1 ½ + lb. wild white clover ¼ to ½ lb.

b) *for grazing only*: perennial rye grass 10-12 lb. + wild white clover 2-4 lb. (sown under about 2 lb. of rape per acre or without any covering crop) Mixtures including coarser grasses such as rough stalked meadow grass (1) may also prove advantageous.

In each case these mixtures would be most applicable to regions of high rainfall, and if intended for use for winter and early spring grazing the addition of a small quantity of cocksfoot, and timothy might perhaps serve a useful purpose

M. L. Y.

612. Composition and Feeding Value of some South African Grasses.

TAYLOR, A. J. (School of Agriculture. Cedara, Natal) *The South African Journal of Science*, Vol XIX, pp 218-232, tables 4, bibliography. Johannesburg, Dec 1922

A considerable number of analyses of South African grasses have hitherto been recorded, but until recently very little systematic work has been done in this direction. During 1921-22 samples were collected at monthly intervals as far as possible at the same stages of growth, in order to study seasonal variations, and analyses made at the Cedara Experiment Farm (Natal). The results are calculated on the dry sample, and tables are given with full details as to the percentage composition and classification of grasses according to percentages of crude fibre, the calorific value and the protein content.

The plants examined are classified into 4 main groups:—

1) Commonly found on waste lands: viz. *Cynodon dactylon*, *Digitaria sanguinalis*, *Eleusine* spp., *Panicum* spp., *Setaria* spp.;

2) Veld or meadow species: viz. *Anthistiria imberbis*, *Andropogon amplexans*, *A. cerasiaeformis*, *Axonopus semialatus* var. *ecklonii*, *Cyperus esculentus*, *Digitaria diagonalis*, *D. horizontalis*, *D. tricholaenoides*, *Eragrostis brizoides*, *E. chalcantha*, *Harpechloa capensis*, *Microchloa caffra*, *Panicum ecklonii*, *P. serratum*, *Tricholaena rosea*, *Tristachya leucothrix*;

3) Coarse grasses: *Andropogon hirtus*, *A. nardus*, *Aristida junci-formis*, *Eragrostis* spp., *Sporobolus indicus*, *Trachypogon polymorphus*;

4) On moist soils: 3 *Leersia hexandra*, *Rottboellia compressa* var. *fasciculata*.

With reference to the percentages of protein both crude and pure respectively, the following species are out-standing: *Cynodon dactylon*,

(1) *Poa trivialis*. (Ed.)

15.3 % and 11.9 % ; *Digitaria sanguinalis* 15.3 % and 12.1 % ; *Panicum proliferum* 13.2 % and 9.5 % *Eleusine indica*, 12.9 % and 9.5 % . *Leersia hexandra* 10.4 % and 9 % ; *Axonopus semialatus*, 10.3 % and 8.8 % , and other *Panicum* spp. are not far behind.

With reference to percentage of crude fibre, the highest is attributed to *Trachypogon polymorphus* 42.5 % ; *Digitaria diagonalis*, 42.4 % and *Aristida junciformis* 41.2 % etc. and the lowest, *Cyperus esculentus* 25.1 % and *Cynodon dactylon* 28.5 % . The calorific value may be judged accordingly ; full data are given for all the plants examined. *C. esculentus* possesses the highest fuel value.

As regards seasonal variation, as a general rule the fibre increases and the protein decreases as the season advances. Interesting ecological observations are made by the author relative to the different groups and the effect of environment on the nutritive value and fibre content *e. g.* *Rottboellia compressa*, transplanted from its original moist habitat to a well-drained hillside soil, flourished under new conditions, matured earlier and the protein content was nearly doubled and of consequent value as a stock feed. Apart from these variations, the grasses on waste lands (Group I), may as a whole be considered to possess a higher feeding value than the ordinary veld grasses (II) and the coarser and inferior grasses in Groups III and IV. The principal veld grass from the stock farmer's point of view is *Anthisteria imberbis* (= *Themeda triandra*).

Results of further experiments made to ascertain the phosphate content of the ash of veld grasses to the deficiency of which is attributed many of the cattle diseases in South Africa, indicate that the average for veld grass is about 0.2 % of dry matter. For grasses on waste, and the amount is about 0.3-0.4 % , but is variable.

M. I. Y.

613. Cotton Grafted on Mulberry Tree.

The Field Illustrated, Vol. XXXIII, No 10, p 32. New York, 1923.

Nine-hundred bolls of cotton were grown on a plant grafted to a root of a mulberry tree in La Marque (Texas) by DAN GEORGE and have given exceptional results. The new cotton produced 15 lb. seed cotton on 3 mother-plants, or at the rate of 4 bales per acre. The plant breeder is perfecting this new variety on a field scale. This season, certain plants are reported to be nearly 8 ft high, and one has 917 bolls, although the cotton season has hardly begun. The staple measures 1-1 1/2 inches and is of good quality.

M. I. Y.

614 Improvement of *Phormium tenax* for the Fibre Industry.

SMERLF, G. *New Zealand Journal of Agriculture*, Vol. XXVI, No. 6, pp. 363-370, figs. 4 Wellington, 1923.

The author was appointed in 1922 by the New Zealand Flax-Millers-Association to carry out investigations at Miranani of the so-called yellow' leaf disease of *Phormium tenax*, to breed plants immune to the disease,

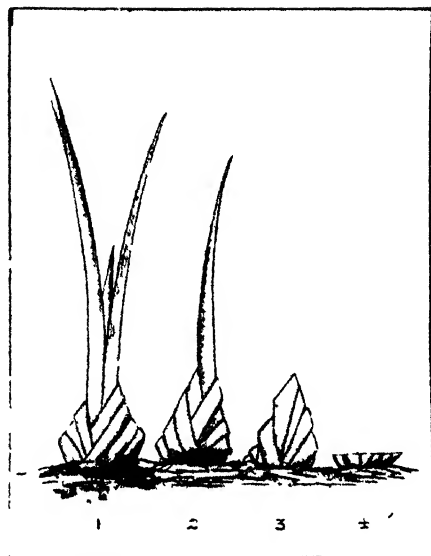


FIG. 104. — Methods of cutting *Phormium*

- 1 Side leaves cut, with 2 mid leaves and centre shoot left intact
- 2 fan cut diamond shape with centre leaf left cut diamond shape
- 3 common method whole fan cut level



FIG. 105. — Seeds of *Afelia Brucei* De Wild.

and to improve the methods at present employed in the cultivation and harvesting of the plant.

The factors studied were: 1) the common method of cutting the leaves, 2) grazing of cattle; 3) weed growth.

Improved methods of cutting. Different methods of cutting the plant were tested and compared with that usually employed, viz., cutting all the leaves off parallel with the ground, which is very detrimental to subsequent growth. The methods compared by the author are shown in the figure (See fig. 104).

Weed growth. Weeds deprive the plant of light and air and add to the cost of cutting the leaf. Plants growing in the open gave 16 % fibre, whereas those in the shade produced 12 % only.

Selection and breeding. More than 20 varieties or types were grown, and particulars of the yield of fibre and resistance to disease are set out in a table, the yield of finished fibre varied from 2.5 % to 18.8 %.

Assuming that a certain area yields 100 tons of fibre every 4 years under the present method of cutting, the author estimates that with improved varieties of plants, better methods of cutting and cultivation the yield should be as follows

Condition of area	Yield by present method of cutting	Yield by side leaf cutting
	Tons	Tons
Average <i>Phormium</i> area	100	300
Area free from weeds	120	360
Area planted with best varieties and kept free from weeds	180	540

W. S. G.

615. The "Khua-piat. Textile Plant of Laos (Indo-China).

Bulletin Economique de l'Indo-Chine Le khua-piat., plante textile du Laos Year XXV, No. 155, p 472 Hanoi-Haiphong, 1922.

The "khua-piat" is a climbing plant fairly common in the Province of Saravane (French Laos) often reaching a length of 20-25 m. and arm thickness. It grows wild in the thick forest areas and also in the dense thicket on the mountain spurs on the Bolevens plain, at altitudes between 400 and 500 m. The fibre is collected in the rainy season from June to September.

The natives strip off the fibre from the stems exceeding finger thickness, detaching from the bark the tough underlying layer. Stripping is more difficult than with ramie which is cultivated in the same regions. The natives show a preference however, for "khua-piat" owing to its resistance to rotting in addition to its strong fibre, important qualities in a moist climate. For example, a fishing net made with "khua-piat" lasts three times as long as a ramie net. The fibre is light coloured and

glossy and fairly short staple (0.40 m.), varying with the size of the internodes, where the filaments split when stripping

As regards nomenclature, it is thought to be a *Pueraria* sp. either *P. Thomsoni* Benth., *P. tonkenensis* Gagnet or *P. Thunbergiana* Benth. (known as "kudzu") (1).

R. D.

616. Oil Plants and Seed Products in Siam.

The Record of the Board of Commercial Development, No 5, pp. 8-17
Tables 13, Bangkok, 1922

The report includes a general review of the value of vegetable oils as a whole, followed by data concerning the most important oil seeds produced on a commercial scale in Siam, viz. castor oil, copra, cottonseed, groundnut, sesame, soya. This comprises area under cultivation, estimated yield, distribution, time and period of ripening, local value, nature of oil, uses, and statistics of exports and imports. Further data is given of the world's production and supply of oil (*Special Agents Series No 75 and Department of Commerce U. S. A.*, No. 89).

A description is given of the somewhat primitive method of oil extraction employed up to the present in Siam, and the typical oil mill. The percentage of oil in the cake and seed respectively is given as follows: copra 13.8 % and 68.0 %; sesame, 10.5 % and 65.5 %; groundnut 4.3 % and 53.2 % (small seed decorticated), castor oil, 5.4 % and 47.5 % (large seed). Owing however, to the crude methods of pressing, the local oils and cakes are of inferior quality and fetch low prices.

Suggestions are made for the establishment of a modern oil-mill employing either the solvent process or the pressing process with efficient disintegrating machines, presses and moulding machines. Two pressings are required to obtain the maximum yield of oil. The working cost of a modern plant should be considerably less than that of the present typical oil-mill in Siam.

It is advised whenever practicable to crush and press seeds *in situ*; the advantage of this has already been proved in other oil producing countries.

M. I. Y.

617 Oil Value of *Afzelia Bieyeri*.

PIERAERTS, J. and L'HEUREUX L. *L'Afzelia Bieyeri* Wild. *Bulletin Agricole du Congo Belge*, Vol. XIV, No 1, pp. 191-200 figs 2. Brussels, 1923

Amongst other interesting observations made by the "Mission forestière et agricole" in the Belgian Congo, that referring to the leguminous specimen *Afzelia Bieyeri* deserves special attention. (See fig. 105). The late DE WILDEMAN gave a full description of this evergreen tree, which the authors quote, giving in addition, further details concerning the habits and distribution of this species which closely resembles *A. Zenkeri* Harms, in appearance. The wood, harder than oakwood is suitable for cabinet

(1) See No 600 of this *Review*. (Ed.)

making, but the commercial possibilities of the oil of the nuts have hitherto been unexploited; the authors therefore after discussion of the morphological characteristics (illustrated), describe the development of the seeds and the results of analyses. These may be summarised as follows:— Average weight 6.44 gms.; size (average) 3.7×2.3 cm.; moisture 8.23 %; matter soluble in water 1.24 %; crude fat 29.84 %; carbohydrates 50.31 %. The ash contains 26.82 % potash and 14.76 % phosphoric acid

The oil extracted with petroleum ether has a light brownish yellow colour and the extract made with sulphuric ether, a reddish-yellow tint. Both are, however, identical as regards taste, which is similar to olive oil. The former maintains its original taste for several days and the characteristics of this oil are given as follows:— Specific gravity at 19.5° C. 0.9320; refractive index (at 40° C.) 1.475; acid value 32; saponification value 183.8; iodine value 144.0. The absence of cyanogenetic glucosides and alkaloids is noticeable. The solidifying point of the fatty acids is given as 52 to 50.5° C.; iodine value 135.0.

Drying tests were made which indicate that the oil does not remain unaltered for long. The day after records were taken, an increase in weight of 1.49 % was observed. Between the 3rd and 43rd days there was less variation, but following this the increase progressed at the rate of 0.54 % until the end of the experiment. Solidification is due to isomerism and polymerism rather than to oxidation which only plays a secondary part in the reaction.

These preliminary tests show the oil value of the seed and the possibility of its employment for food purposes and also as a lamp oil. The residual meal has an agreeable taste and would supply a useful stock feed. Meal containing 7–8 % oil compares favourably with the well-known coconut meal, palm oil residue, etc.

M. L. Y.

618. Oil value of *Cyperus esculentus* Tubers.

PIERAERTS J (Directeur du Service Chimique du Ministère des Colonies de Belgique). Le souchet comestible. *L'Agronomie Coloniale*, Year 9, No. 67, pp. 7-21. Paris, 1923.

The author refers to foregoing investigations made with Cyperaceae tubers and draws attention to the high boric and comparatively high manganese content and the equal proportions of lime and magnesium. According to available information and the detailed analyses made by the author, the oil may be termed of first class commercial value. The saponification value is high, viz. 191.3; iodine value 76.89 %; glycerine 8.82 %. The oil does not congeal and readily withstands low temperatures. The fact that rancidity sets in remarkably slowly is a distinct advantage. The sample tested was exposed for several days to the sun's rays and the acid value remained constant; after 8 months the alteration amounted only to 2.85 (i. e. 1.45 % oleic acid).

The value as a superior quality table oil has been confirmed in several countries, but extended use in soap factories and as a substitute for

olive or almond oil for medicinal purposes should be considered and after the separation of the heavy oils it is suitable for oil cloths, and wool carding, etc. The oil should emulsify easily as it resembles olive oil. The point of inflammability is similar to castor oil (245° C.) which, with its degree of viscosity renders it suitable as a lubricant.

The author considers that this oil is in many respects superior to olives and groundnut oils from the industrial standpoint, provided that extraction is made in a systematic manner and the products utilised to the proper advantage.— 1) edible oils obtained by cold pressure; 2) oil for industrial purposes obtained by hot pressure, followed by extraction with solvents; 3) saccharose obtained from residual meal; 4) starchy residue, a whitish farinaceous material without smell and with an agreeable taste. If well dried at a low temperature this should be useful in many respects.

M. L. Y.

619 Oil Value and Yield of *Camellia* spp.

DEUSS, J. J. B. L'huile grasse des graines de thé *L'Agronomie Coloniale*, Year 8, No 66, pp 161-171, figs 2, Paris, 1923

Several attempts have hitherto been made to extract oil from seeds of *Camellia* spp. but until recently little value has been attached to the oil from the commercial standpoint. The author reviews the investigations made by different planters and oil analysts and draws attention to the confusion frequently made with the various species, e. g. between *Camellia sasquanqua* and *C. drupifera* etc. The author, however, studied especially oils from *C. theifera* var. *assamica* and *C. theifera* var. *sinensis* and deals solely with the fatty oil content of the seeds and not with the essential oil obtainable from the freshly fermented leaf. (See ROMBURGH and LOHMANN, in *Vierde Verslag over de onderzoeken, betreffend op Java gecultiveerde theen*).

The viscid oil in question has neither scent nor taste and is used for cooking and medicinal purposes, and as a lubricant, owing to the absence of free acid; it is sebaceous but not bitter and resembles codliver oil and olive oil. An interesting comparison is made between saponification values of the oils from seeds of China, Japan and Assam teas, viz. 195.5 188.3 and 194.0 respectively. The residual meal after extraction is white and although fairly viscid it soon acquires a bitter and astringent taste and is therefore unsuitable as a stock feed. The nitrogen content does not exceed 1.58 to 1.92 % and never less than 12 % crude protein; ash 3.3 to 4 % (average 0.58 % phosphoric acid).

In China the irritant nature of the residual meal from *C. oleifera* has been used to keep off insect attack and for washing horses.

The system adopted by the natives in Java for oil extraction has its disadvantages. Husking is followed by cold pressure, but this has no effect on the saponin content, and the oil is consequently unsuitable for human nutrition. Heat pressure is therefore advised, although the quantity of saponin in clear oil is according to BOORSMA, negligible. Sun drying is not considered sufficient, but a stove heat of 100-105° C. is preferable, to com-

pletely dry off the moisture. Dried grains can be easily crushed and the saponin eliminated by means of benzine or preferably tetrachloride of carbon. The liquid turns yellow rapidly and under normal conditions will remain thus, resembling olive oil in appearance. Calcium chloride may be employed to finally remove remaining traces of moisture. The average yield of oil is stated to be 42 % dry weight. The author has solidified the oil by means of hydrogen and platinum black (Van LEENT method), and obtained a light coloured fat, melting point 35.5 C.; refractive index at 40°C 1.4579, iodine value 41.7; saponification value 175.8.

M. L. Y

620. Mangrove Species as a Source of Tannin in Madagascar.

SCHÉLL, E (Président de la Section française de la Société des Chimistes des industries du cuir) Ecorces tannantes de la mangrove de Madagascar *Bulletin de l'Agence Générale des Colonies*, Year 16, Nos 186-187, pp 712-726 + tables Melun, 1923

A large number of tannin barks of doubtful value have been put on the market and have been wrongly classed as mangrove species. Hence the subsequent depreciation in value of the true mangroves. The author proceeds to describe in detail the various species growing in Madagascar and the analyses of the so-called male and female species; the former has a high tannin content 34-42 % (absorbable) and only 0.3 to 2 % (insoluble). The true tannic value of all the barks examined varied from 73.4 % to 83.6 %. The especial value from the commercial standpoint of *Rhizophora* spp., *Bruguiera* spp., *Cerriops* spp., and *Carapa* (*Xylocarpus*) spp. is emphasized (1). The season at which the bark is stripped appears to have a definite importance in connection with the quality of *Rhizophora* spp. and in Madagascar the reports indicate that the last months of the year are preferable, to ensure rapid and complete drying and avoid danger of mould. Under favourable conditions the tannin obtained thus possesses a good colour suitable for leathers, superior in many respects to artificial tannin extracts. The author considers that a higher value should be attributed to such barks, which in pre-war years were exploited solely for adulteration purposes and later in mixtures which have not proved altogether successful

M L. Y.

621. Possibilities and Cost of Growing Hevea in the Belgian Congo.

LEPLAE, E. (Professeur à l'Université de Louvain, Directeur général de l'agriculture au Ministère des Colonies de Belgique) Le succès de l'hévéa au Congo Belge. *Revue de Botanique appliquée et d'Agriculture Coloniale*, Year 3, No 20, pp 247-252. Paris, 1923

Although climatic conditions in the Belgian Congo are on the whole unfavourable to rubber growing, certain areas are adaptable. Insufficient attention has been given to the fact that even if the yield is limited, it is

(1) This confirms the opinion expressed in Bengal (India). See R. 1922, n° 172 (Ed)

invariably worth the cost of outlay. The most suitable area in the Congo is situated near the Equator between Lukolela and Stanleyville where the average day temperature is 21° to 31° C in the shade. The rainfall is estimated at 60 to 61 inches, well distributed throughout the year. The dry season occurs about January, but even then five or six showers each month may be expected, often accompanied by a thick morning mist.

The soil is sandy and poor even in the equatorial zone, the alluvial deposits in the Congo being of sand. Clay and fertile soils are rare but this is partially compensated by the extreme cheapness of land and the low rate of wages paid for labour, which is only half as much or even less than that paid in other equatorial region. The rates of pay for white people are also less than in Asia. A labourer's daily wage, food included is stated to be 1 franc (Belgian) in the Upper Congo and this is the maximum in the Equatorial zone.

As regards clearing the ground, economies may be effected as regards the actual felling by arrangement with the native chiefs, by the sale of the timber and by planting catch crops, coffee and other food plants with the exception of manioc being found too exhausting.

For clearing which demands merely felling and burning, the cost is estimated as follows, including only the wages for native labour. The figures therefore show the number of days required to clear 1 hectare and the cost of the labour. The expenses necessary for clearing for coffee, cocoa and *Elaeis* palm are also given.

	Grassland pasture	Brushwood	Forest light or medium	Forest heavy or virgin
	Days and Fcs.	Days and Fcs.	Days and Fcs.	Days and Fcs.
Hevea	150	400	600	900 to 1000
Coffee	75	100	300	500
Cacao	75	100	200	400
Elaeis	50	100	200	400

The cost of planting is given as follows.

	Hevea at 7×3 m or 476 trees per ha	Cacao at 4×4 m or 625 trees per ha	Coffee at 3×3 m or 1111 trees per ha	Elaeis at 7×7 m or 200 trees per ha
	Days and Fcs.	Days and Fcs.	Days and Fcs.	Days and Fcs.
Nursery work	20	20	20	20
Holing	24	32	55	10
Filling up	24	32	55	10
Planting	24	32	56	10
Paths and trenches	10	10	10	10
	102	126	196	60

As regards supervision, a white man is essential, and the payment is calculated at 80 to 250 fcs. per hectare per annum. The construction of European dwellings requires 1000 to 2500 one-man working days, with rebuilding after 5 years.

Tapping may be started in the fifth year after planting; in the intervening years the cost of maintenance is estimated at 50 to 60 fcs. per hectare per annum.

R. D.

622. Rubber Grafting (1)

MARTIN, A. A., propos de la Greffe de l'Hévea. Les grands producteurs ne seraient que des malades. *Bulletin de l'Association des Planteurs*, Vol. X, No. 506, pp. 83-84. Antwerp, 1923.

On the rubber plantations under the direction of the author, a dozen trees have been reported giving 100 to 125 gm. of dried rubber per day; others gave only 25 gm. and 3 to 5 gm. In every case the trees were 12 years of age, but in the early stage of development had suffered from the attacks of wild boars, and deers and had been stifled by *Musa textilis*.

Tapping was commenced after 2 years. The trees giving the highest yield possessed large latex vessels but with the rest, these were poorly developed. From one tree, only 3 gm. per day were obtained and then unexpectedly the yield amounted to 75 gm. in a few weeks time, without any apparent change outwardly.

A trench 2 m. breadth was dug round the tree, and the roots carefully inspected. At a depth of 1 metre a compact mass of rubber, estimated to weigh about 4 kgm., was found on the tap root, and after removal MARTIN noticed that the root had rotted and was attacked by parasites. The sudden increase in latex yield was due to the control of the pests; the latex vessels were subsequently very well developed. In some months, the tree had a totally different value.

A similar operation was effected for the trees giving a latex yield of 100 to 125 gm. and exactly similar conditions were found; the roots were suffering from rot. Before selection of buds for reproductive purposes, it is therefore advisable to ascertain the cause of high yields and whether these are not the outcome of a morbid condition.

No special remark need be made as regards trees giving 20 to 30 gm. per day, and which have maintained this yield from the outset, as they may be considered to be normal.

R. D.

623. The Treatment of Budded Hevea Seedlings.

MILSUM, J. N. *The Malayan Agricultural Journal*, Vol. X, No. 2, pp. 47-50, figs. 8. Kuala Lumpur, 1922.

The propagation of rubber trees by budding was described in a former article (2). The author advises that no budding should be done during the rains as mould may enter the wounds.

(1) See R. No. 2 1923, Nos. 201 and 202. (Ed.)

(2) See R. No. 3 1923, No. 383. (Ed.)

After the bud has become well united with the stock the upper part of the latter should be cut off to within 1 ft. of the dormant bud. The best time to transplant the stump to the field is when the shoot has grown from 1-3 inches long, but before the formation of any leaves. A few months later the portion of the stump above the shoot should be sawn off and the cut surface coated with yellow paraffin wax.

Marcottage — By this means it is possible to have young trees on their own roots and so avoid any possible effect of the stock. The budded stumps should remain in the nursery for a year after budding. A ring is then cut at the base of the scion and a narrow piece of bark removed to the depth of the cambium after which a bamboo basket is placed round the young marcot and filled with light, rich soil, kept moist by daily watering. In about four months roots will have formed and the young seedling can then be severed at the junction with the stock and planted out in the field.

This system entails extra expense and more time is necessary for the establishment of the trees.

In the case of budded *Hevea* stock, thinning out should not be required and 70 to 80 trees per acre would give a sufficient stand when in bearing.

W S G.

624. Results of an Enquiry into the Preparation of Sheet Rubber in Java.

VAN DILLIEN, L. R., *Uitkomsten van de enquête over sheetbereiding. Archief voor de Rubbercultuur in Nederlandsch Indië*, Year VII, No 2, pp 47-59, tables 2 Buitenzorg, 1923

In the spring of 1922, the Rubber Experiment Station at Besoekei (Java), instituted an enquiry into the method of working, the cultivation and the yield per hectare of the different rubber plantations. Questionnaires were sent to the owners of fifty plantations accompanied by the request that a sample of the product of May 1, 1922 should be forwarded to the Station. These samples were to be forwarded for examination to the Central Rubber Station at Buitenzorg after having been previously examined by a Commission of brokers for valuation from the commercial standpoint. The Station received a total of 51 samples accompanied by answers to the questionnaire. Results of the enquiry:

Treatment and coagulation of latex.

1) The latex concentration in the district of Besoekei is somewhat low. The enquiry has proved that in 22 plantations, the trees are tapped every day; in another 22 plantations, they are only tapped every other day; and in the rest of the plantations a mixed system is adopted. The average percentage of latex when the trees were tapped daily was 27 and when the tapping was effected every other day it was 28 (although 30 and 35 % might well have been expected).

2) The figures for the latex percentage in lump rubber are often too high, 2 % may be regarded as normal, but in some samples the percentage rose to 6 or 7.

3) As a rule, the latex is diluted to 15 % It is very necessary to weigh the sheets from time to time and to compare the actual weight with the theoretical weight, viz., the weight calculated from the number of litres of dilute latex introduced into the vessels.

4) Sufficient care is often not taken to see that the right amount of dilution is effected.

5) The managers usually avoid as far as possible the use of chemical substances such as anti-coagulants and anti-oxydants.

6) The amount of acetic acid used for coagulation per litre of latex varies. The figures obtained are not comparable, because anti-coagulants are employed in some plantations; further in some cases, the rubber is coagulated the day the tree is tapped, whereas in others it is left till the following day. The average in the case of 8 plantations where no anti-coagulants were used and the treatment was carried out on the day of tapping, was 128 c.c. of 1 % acetic acid per litre of dilute latex, but only 120 cc. in 10 plantations where the operation was deferred until the following day.

7) There are many variations in the methods of making the sheet rubber. The mass is gradually rolled and pressed to the fullest extent on the same day. The sheets are washed during the night, and on the following day they are suspended for some hours in a current of air and subsequently smoked.

The avoidance of air-bubbles and oxidation patches are some of the chief advantages of this system.

8) Driers with different compartments are generally used. The average length of the drying operation on 46 plantations is 14 days. The colour of the sheets varies according to the smoking method adopted.

The rollers also vary greatly in the different plantations. The largest rollers seem to be the most effective as they can turn out heavier sheets which increases the capacity of the machine (number of kg. of rubber per hour). The capacity is much influenced by the number of sheets passing through the machine. Further, the sheets can be made of a given width which is very important for packing. Spirally engraved rollers give the best design for square blocks.

The susceptibility to mould is determined by cutting off a small piece of the sheet, which is then infected with mould and placed in a desiccator with a 7 % solution of sea-salt. The growth of mould at the end of 6 days is regarded as showing average susceptibility. Most of the samples were only slightly susceptible

Estimation from the external characters as compared with estimation from the internal properties.

10) The thickness and the print were generally good. The prescribed thickness is 3-4 mm. which was attained by 37 samples. Thinner sheets are soft, while very thick sheets dry too slowly and always retain a certain amount of moisture. Too flat a sheet also dries with difficulty.

11) The brokers' Commission passed 34 samples, 7 of which were judged as "very good" and 27 as "good"; 10 were pronounced "in-

ferior", or objected to by one of the members; 7 samples were rejected by the Commission, which exceeded the number expected.

12) The elasticity was quite satisfactory on the whole. A margin of 10 % can be allowed for the time required for vulcanisation. The average for all the samples was 98.7, or in round numbers, 100 minutes, but one sample took 125 minutes.

At the Central Station, 36 samples were pronounced good, and uniform as regard their internal characters. Of these 36 the Commission rejected 5 and classified 8 as doubtful.

One of the samples accepted by the Commission was rejected by the Station. Five samples were regarded as doubtful by the Station; of these 4 had been cured too quickly and 1 too slowly. The Commission accepted 3 of these 5 samples and rejected the other two.

Thus, the verdicts of the Station and Commission did not always coincide, but they invariably agreed when the samples were rejected on the score of impurity.

D. v. S.

625. The Smoking of Rubber.

ULTEF, J. A., Het rooken van rubber *Archief voor de rubbercultuur in Nederlandsch-Indië*, Year VII, No 2, pp 60-74. Buitenzorg, 1923.

I. Historical Review.

The author has made a series of experiments on smoking rubber at Djembar (Java) and in the present paper, he gives the results of those investigations that it is useless to continue. The first part of his article contains a historical review of the question of smoking rubber, the following authorities being quoted.

PIT and JONG. *Compte rendu de l'exposition de caoutchouc à Singapoore en Août 1906 (Teysmunnia)* p 641, 1906.

N. N. *Compte rendu de l'exposition de caoutchouc à Ceylan en Septembre 1906 (Rubber in the East etc. 1906)*.

HERBERT WRIGHT, *Hevea brasiliensis*, 1908.

SCHIDROWITZ. *Rubber*, 1911.

SIDNEY MORGAN *The Preparation of Plantation Rubber*, 1913.

EATON, *The Agricultural Bulletin of the F. M. S.*, Vol. III, 188, 1915

CAMPBELL, *Bulletin* 27, 1916, *Department of Agriculture*, Ceylon.

WHITBY, *Indian Rubber Journal*, 51, 829 (1916).

DE VRIES *Bereiding en Eigenschappen van Plantagerubber* 102 p., Estate Rubber pp. 316.

The author agrees with EATON, who says that smoking has no deleterious effect upon rubber; at most, it may slightly increase the length of the vulcanisation process, but for practical purposes, there is no object in continuing research on the effect of the smoke treatment upon the internal properties of rubber.

No way of preventing mould by smoking has yet been discovered. It is generally admitted that the tendency to mould formation is decreased by immersing the sheets of rubber for some hours in running water, but this treatment has many disadvantages, therefore an attempt is now being

made to regulate the smoking process in such a manner that the disinfecting action of the smoke may act long enough to make washing unnecessary.

II. *Increase of weight by smoking.* — The author has estimated this increase by comparing two sheets made from the same latex, one dried by smoking, and the other dried at the same temperature without smoking. He applies the term "smoking coefficient" to the weight of a sheet expressed in percentages. The author is of opinion that this coefficient should vary between 0.50 and 0.75 %. If bisulphide is used as an anti-oxidant, as much as 1 % may be employed without the sheet appearing over-smoked. As it is almost impossible to conduct the experiments under absolutely comparable conditions, all that can be done is to reduce the errors by making a large number of experiments.

The author analysed 9 different sheets before and after smoking. He estimated the ketone-soluble substances and the loss in weight at 100° C. The sum of these two values in the case of smoked sheets, less the sum of the same values in that of the unsmoked sheets, is generally equal to the smoking coefficient; in some cases, the coefficient is lower, which means that the rubber absorbs during the smoking process, substances that are not soluble in ketone. This is especially noticeable in the smoking of crêpe.

III. *Effect of smoking on the viscosity.* — With the object of ascertaining the effect on viscosity of the smoking treatment as practised on the different estates, certain sheets of damp rubber were divided into several parts that were sent to be smoked; lot *a*: all the pieces were smoked for the same number of hours; lot *b*: all the pieces were smoked till they assumed the same colour as the product of the plantation in question. The differences in viscosity were not great. This property was found to be sometimes decreased and at others increased by smoking, which has a very irregular effect upon the rate of vulcanisation, but the author does not assert that any correlation exists between rate of vulcanisation and viscosity, for before this could be proved it would be necessary to conduct special investigations.

D. v. S.

626. The Cultivation and Industrial Value of Lac in the Plains of India.

MISRA, C. S. (First Assistant of the Imperial Entomologist). *Agricultural Research Institute, Pusa, Bulletin* 142, pp. 1-82, plates XXIII, figs. 14. Calcutta, 1923.

The lac industry is very widespread in the Plains of India and helps the cultivators to tide over financial stress at a time when rates are low and climatic conditions are against them in disposing of their produce on the market. On an average over 450 000 maunds (1 maund = 80 lb.) of shellac is exported yearly from Calcutta. The methods of refinement are similar to those adopted in Indo-China (1).

The author describes the distribution areas in the Plains and the

(1) See R. 1916, No. 895, R. 1919, No. 207 and R. 1921 No. 950. (Ed.)

trees on which *Tachardia lacca* is found growing spontaneously, the chief being "ber" (*Zizyphus Jujuba*), "palas" (*Butea frondosa*), "Kusumb" (*Schleichera trijuga*), "pipal" (*Ficus religiosa*), "bubul" (*Acacia arabica*), "arhar" or "tur" (*Cajanus indicus*). Full details and illustrations are given of the brood-lac and inoculation process, localities suitable for lac, instruments, time and labour required for the work, pruning methods, life history of *Tachardia lacca* (1) determination of the emergence of larvae, natural enemies, yield and scraping, storage and washing processes. The importance of fumigation with carbon bisulphide is emphasised, owing to the harmful effect of insects (details of fumigation box are described). Observations on the value of washing, show that 80 lb. of "ber" stick lac ground and washed with water will yield 37 lb. of clean seedlac with 30-32 gallons of workable lac-dye.

The various uses of the pure resin known commercially as seed-lac (for shellac) and of lac-dye are given and the manufacturing process adopted in India. Warnings are given as regards adulteration of shellac, and the advisability of having direct specifications from the manufacturers.

Recommendations for the extension of lac cultivation: — 1) The issue of reliable forecasts. The sudden market fluctuations have hitherto led to slackness on the part of cultivators and subsequent decrease in yield; 2) Manufacture of unadulterated shellac; discarding of adulterated material; 3) Establishment of nurseries; 4) use only of "phunii lac" i. e. stick lac collected after the emergence of young insects, and never of material collected before swarming; 5) utilisation of neglected areas of poor soil for *Zizyphus Jujuba*, and *Butea frondosa*, which require little care when once established. Cultivation on the block system is advised with shade plants such as *Bassia latifolia*, *Pongamia glabra* and *Acacia arabica* between the rows. These trees have an industrial value for motor fuel; *Schleichera trijuga* is advised for clay soils, preferably near water; this tree becomes fit for inoculation 15-20 years after planting and serves also a useful purpose as timber and for oil supplies; 6) exchange of brood lac: — broods from *Zizyphus Jujuba*, should be put on other trees of the same species. This holds good also for *Butea frondosa* and *Schleichera trijuga* although in the last case in the Central Provinces an exchange from *S. trijuga* to *B. frondosa* has proved successful. In West Bengal good results have been obtained by putting *B. frondosa* brood lac on *Z. Jujuba* but not vice-versa.

The appendix includes data relative to all trees on which lac can be grown with their botanical and provincial equivalents. Apart from those already mentioned, these include: *Ficus benghalensis*, *F. infectoria*, *F. glomerata*, *Albizia Lebbek*, *Shorea Talura* and *Zizyphus Xylopyrus*. Some useful formulae for use of small quantities of lac produced locally and which have no marketable value are given: 1) for making spirit varnish (methylated spirit 10 oz. + white resin 1 oz. + seed lac 1 oz. + Dragon's blood 1 oz.; 2) for making French polish (methylated spirit 20 oz. + seed lac (ground fine) 2 oz. + boiled linseed oil (small quantity).

With reference to cost of production, the author states that no ac-

curate figures can be given owing to the recent rise in wages and prices of brood-lac. Special reference is made to the economic system adopted in Bengal and Bihar and Orissa: the "ber" trees are grown on the field embankments, out back very year carefully and inoculated with brood-lac. A good-sized "ber" will yield about 40 lb. M. L. Y.

627. Tapping of Karai Gum (*Sterculia urens*), in India.

ABDUS SALAM, M. *The Indian Forester*, Vol. XLIX, No. 6, pp. 303-306. Dehra Dun (United Provinces), 1923.

Different methods of tapping *Sterculia urens* for the "Karai" gum have been tested in the Central Provinces, India (Melghat Division), and from the available data it appears that the highest percentage of gum is obtained from the "4-oblong notch system" (one on each side of the tree and extending about $\frac{1}{4}$ of its girth; lowest notch 2 ft. above ground), giving an average per tree of 59 lb. The removal of the 6 ft. wide band from all sides, *i. e.* light girdling, has also been found successful; average yield per tree of 57.5 lb. The importance of a straight clean cut and removal of the gum after it is fully dry is noted. The quality of the gum is superior and the method of collection is easy and under normal conditions and provided that the trees do not lose their vitality after the rains are over, these methods can be highly recommended.

The following observations were made during the course of this experiment:

- 1) Trees situated on northern or eastern slopes give more gum than those situated on southern or western slopes.
- 2) Notches cut on the northern or eastern sides of the tree are the most effective.
- 3) Loam or alluvial soils are preferable to rocky or precipitous slopes.
- 4) Trees in shade give more gum than those standing in the open.
- 5) Wet or fresh gum loses about 15 % weight in drying.
- 6) At least one month should be allowed before the first collection of gum is made, to allow the gum to exude and dry properly. Subsequent collection may be made once a month. M. L. Y.

628. Camphor Cultivation from *Cinnamomum Camphora* in Northern India.

HOWARD, H. S., ROBERTSON, A. H., and SIMONSEN, J. L. *Indian Forest Records*, Vol. IX, Part VII, pp. 1-34 Plates 5, tables 6. Dehra Dun, 1923 (1).

Camphor is principally grown in Formosa and the world's supply is largely controlled by Japan. The Japanese and Chinese distil camphor from the wood of mature trees, a destructive method. The author's experiments have been carried out on a small plantation established at Dehra Dun in 1898, with a view to ascertaining the yield per acre, using

(1) See R, 1920, No. 328; R. 1920, No. 646; R. 1921, No. 294; R. 1921, No. 1006. (Ed.)

*Forecast of yield per acre of a fully stocked plantation spaced 7 × 7 feet
under Dehra Dun conditions.*

Yield calculated on weight of material in column 4														
	Weight (Leaves)			4	Crude Camphor		Camphor oil		Camphor and oil		Camphor redistilled from oil (col. 7)		Total Camphor col 5 and col. 7	
	Green	Air dried	Dried at 100° C.		Total	Per cent.	Total	Per cent.	Total	Per cent.	Total	Per cent.	Total	Per cent.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	
	lbs.	lbs.	lbs.	lbs.		lbs.		lbs.		lbs.		lbs.		
Per acre per annum	83.70	40.50	31.50	13.86	0.44	100.17	3.18	114.03	3.62	30.05	30.00	43.91	1.39	

the leaves as the source of camphor in place of the tree itself, also to find the number of flushes of leaves which might be taken per annum.

It was found that a new leaf takes about two months to grow to full size after a flush had been cut, and four flushes were taken from May to November, but little difference was found in the yield of camphor whether two or four flushes were taken, due probably to the higher camphor content of more mature leaves.

A forecast of yield is given by the authors, based on data obtained during three years' investigations, full details of which are given in the article.

When forming a plantation it is recommended that seed be germinated in a nursery and the seedlings transplanted rather than that the sowing be made in the field. At 5 years the plants will be large enough for cutting back, although full yields may not be obtained until a little later. Details are given respecting transplanting and cultivation.

The distillation of the camphor is fully described, and the financial prospects of the industry discussed.

As a result of their investigations the authors conclude that camphor may be easily cultivated in all parts of India with a rainfall of 40 inches and over, but that as a commercial enterprise it should not be grown outside the tropical areas.

W. S. G

629. *Copaifera* spp. and Production of Copal Oil in Brazil.

TEIXEIRA, E. Huile ou baume de Copahu *Ministère de l'Agriculture, de l'Industrie et Commerce, Service des Renseignements*, pp. 1-8. Rio de Janeiro, 1923.

Species of *Copaifera* are found growing abundantly in Brazil, especially in the State of Rio de Janeiro. The author gives a brief review of the oil value and the synonyms employed relative to the different types. Special attention is drawn to the observations made by M. LE COIMTE in the Amazon district.

In the north, *Copaifera reticulata* has the highest oil value, followed by *C. Martii*, noted also for the superior quality wood. Further south, the species *C. officinalis* and *C. Langsdorfi* are the most common.

The yield of oil per tree is estimated at 4-5 litres, and at times as much as 15-18 litres (80 %). The author gives a description of the chemical composition and general characteristics of the oil. Distinctions are also made between the appearance of the trees. The method of extraction recommended by LE COIMTE is given namely the insertion of a bamboo in the trunk having first made a hole in the upper and lower portions of the bark. The oil passed through the bamboo tubing is easily collected.

Data relative to the exportation of copal oil from Brazil since 1863 are given. In 1921 the exports amounted to 135 518 tons (valued at 250 contos, 434 milreis). A table shows the exportations into Argentina, England, France, Germany, Italy and the United States, years 1910-1918.

M. L. Y.

630. "Resine de Canarium" of Tonkin.

Bulletin Economique de l'Indochine, Résine de Canarium du Tonkin. Year 25, No 154, pp. 359-360. Hanoi, 1922.

This oleoresin derived from a species of the Fam. *Burseraceae* growing in Tonkin is a black, fairly plastic and tough material, slightly sticky and with a lemon coloured and glutinous interior, and with a pleasant odour. The composition is similar to other resins, but in this respect, the lack of saponifiable resins, capable of giving acid resins should be noted.

The sample examined, however, contained 28.8 % by weight of resinous substances, but quite apart from the question of reaction and classification.

The proportion of volatile oil is 12.3 % and after distillation is considered of commercial value as a fairly cheap perfume. If distillation is carried out at a comparatively low cost and regularly, it should be possible to produce sufficient quantity to act as a substitute for the increasingly scarce and costly terebenthine, to supply local and export needs.

R. D.

631. The Time of Harvest in the different Sugar-Producing Countries.

V. HARREVELD, J., De ovgt tyd in verschillende suikerlanden. *Archief voor de Suikerindustrie in Nederlandsch-Indië*, Year 31, No 36, pp. 43-946, figs. 2. Soerabaja (Java), 1923.

The American Sugar Refining Company prints in its annual report for 1922 of the world's sugar production in relation to time of harvest, a graphic chart which we here reproduce :

The outer circle is divided into 12 equal segments representing the months of the year. The sugar production in the different countries is shown by dark lines. The size of the harvest is given by the distance between these lines and the central point of the circle. In order to facilitate comparison, amounts up to 1, 2, 3 and 4 million tons are shown by the radii of concentric circles. Europe, considered as a unit, is the only producer with an output exceeding 4 million tons. In this chart, Australia with a production of 250 000 tons, and Africa with an output of 550 000 tons, do not appear, probably because these figures are the returns from many small crops that are not large enough to be introduced into the diagram.

Let us study the chart beginning with *December*, when the season of two of the largest producers begins. At this time the sugar-beet harvest is at its height in Europe ; the sugar-cane harvest is beginning in Cuba and British India, while it is in progress in many parts of South America (Brazil, Peru, Demerara) ; in the United States, the sugar harvest is drawing to a close, it is beginning in Hawaii, and in progress in Formosa and the Philippines, while it is at its height in Louisiana.

In *January*, the sugar-beet harvest is at an end in Europe ; the sugar season is gradually reaching its maximum in Cuba, is in progress in British India and some of the countries of Central and South America (West Indies, San Domingo, Peru, Brazil), as well as in Hawaii and Formosa and

the Philippines, though it is only just beginning in Porto Rico and is finished in Louisiana

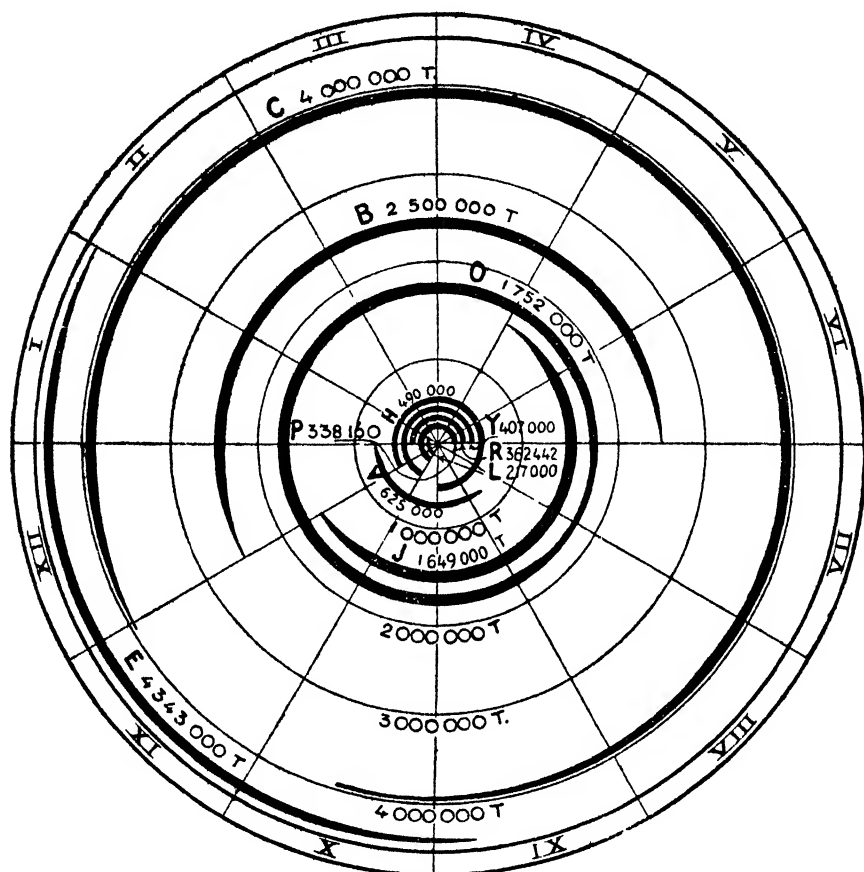


FIG. 106. — Sugar Production in different Countries (in Tons).

I-XII = Months of year.

B = British India

C = Cuba

E = Europe

H = Hawaii

J = Java

L = Louisiana

P = Philippines

R = Porto Rico.

V = Various

Y = Japan, Formosa.

In *February*, the sugar season is in progress in Cuba, British India, several parts of Central and South America (West Indies, San Domingo, Peru, Brazil) and in Hawaii, Formosa, Porto Rico and the Philippines. Except in the case of Brazil, where it finishes in February, the sugar harvest continues through March, April and May, while it begins in the latter month in Demerara, Argentina and Java.

In *June*, Cuba is still occupied with the sugar harvest but it is finished in British India. As regards Central and South America the season is finished, whereas it is still in progress in the West Indies, San Domingo, Peru and Argentina; it attains its maximum in Java and Hawaii and ends in Formosa, Porto Rico and the Philippines.

In *July*, the sugar production of Cuba begins to fall off greatly; of the States of Central and South America, Argentina and Peru alone have a large output, the harvest is in progress in Java and Hawaii.

In *August*, only a few sugar-factories are working in Cuba; the figures for Central and South America, as well as for Java and Hawaii, are the same as in the preceding month. The sugar-beet harvest begins in the United States.

In *September*, the last factories in Cuba are shut down; it is quite exceptional for any to continue working up to October. No change in Central and South America — Java and the United States are beginning and Hawaii is finishing the season.

In *October*, the beetroot sugar season begins in Europe. In Cuba the sugar season is ended; in South America, Demerara and Brazil it is beginning; in Peru and Argentina it continues, as it does also in Java and the United States.

In *November*, the sugar season reaches its height in Europe; in South America, Demerara, Brazil, and Peru it is in progress, while in Argentina it is at an end, and also in Java. In the United States, the beet sugar industry is working to the fullest

extent; in Formosa, the Philippines and Louisiana, the sugar season is beginning, in fact, in the latter State, it may be said to have commenced in October.

It would appear that sugar-production never stops, but as always in progress in a certain number of countries with a large output (only countries producing over 100 000 tons of sugar per annum have been taken into account). There are, however, considerable differences in the number of tons produced. Graphic chart No. I registers the production of nearly 17 million tons. The total production each month can also be shown graphically.

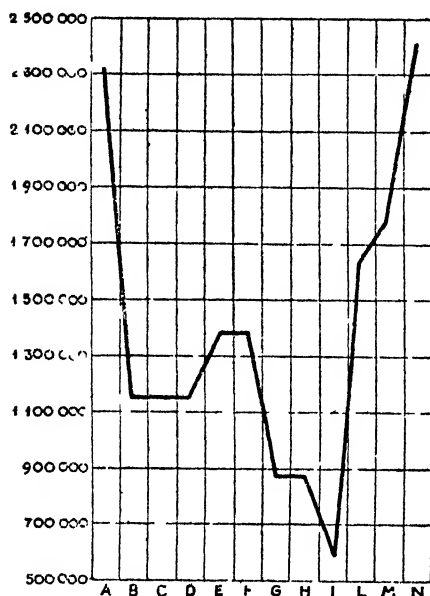


FIG. 107 — Total sugar production for various months. Letters A-N = months of year.

Expressed in thousands of tons, it would be as follows :

January	2380	July	875
February	1150	August	875
March	1150	September	586
April	1150	October	1623
May	1385	November	1789
June	1385	December	2404

These figures are represented graphically in fig. 108.

Thus, September marks the lowest level of the world sugar production which later rises rapidly to attain its maximum in December and January, to again decrease regularly with a slight rise in May and June.

D. v. S.

632. Deterioration of Sugar-Cane after Cutting.

LEE, H. A. and CLARA, F. M. *Journal of the Board of Agriculture of British Guiana*, Vol. XVI, No. 2, pp. 99-101. Demerara, 1923.

The work was undertaken to ascertain the loss in sugar between harvesting and milling the cane.

The first experiment was to determine the loss caused by topping cane, that is, cutting off the points for seed, and allowing the cane to stand in this condition. It was shown that cane harvested and milled the same day gave a polarisation of 16.74 % and a purity of 89.1 % whereas when cut and carried four days after topping, these figures had fallen respectively to 13.91 and 73.2.

The second experiment ascertained the loss caused by cutting cane and allowing it to lie in the field before loading and milling. The results are shown in the following table :

Day	Polarization %	Purity %
1	16.56	89.0
2	15.20	81.0
3	14.78	77.0
4	13.80	71.1
7	13.68	68.7

These data show the necessity for rapid handling of cane when harvesting, so as to avoid the loss which occurs when cane is allowed to lie in the field after cutting and before it is milled.

W. S. G.

633. Tea Selection in Java from 1915 to 1920,

COHEN STUART. Dr. C. P. Verslag over de selectie-werk Laamheden 1915-1920. *Mededeelingen van het Proefstation voor thee*, No. LXXXII, pp. 1-60, figs. 7. Batavia, 1923.

This report is a continuation of Mededeeling XL, (1916) where a detailed account of the various problems involved in tea breeding is to

be found. This paper deals with four sorts of selection work: 1) work done in the seed garden at Tjinjiruan (Bandoeng); 2) accurate description of the characteristics of commercial seed types; 3) the creation of special seed gardens (immunity, quantity, quality); 4) study of the literature on foreign tea districts and the import of new types

1) As the nurseries have been used up entirely, the selection gardens at present chiefly consist of seed gardens. Besides some plants and seeds received from Cochin-China in 1916 and plants obtained from Tonkin were planted in the type collection. Seeds and plants from Siam received in 1918 did not turn out well.

The author explains why the seed gardens at Tjinjiruan are designated by population numbers instead of the current commercial names, which would be misleading to the real nature of the selected seed types, and would divert the attention of purchasers from the object, to obtain seed types excelling in essential properties (viz — large production, immunity against *Helopeltis* etc.), not in names or in outward appearance. Besides the original populations have been selected and thinned out until only about 0.1-0.2 % are left as mother trees.

The author includes figures showing a good mother tree, views of the populations after thinning out, and a simple device for counting large numbers of tea seeds.

2) Repeatedly the author was requested to formulate the botanical characteristics distinguishing the commercial types. Such "ready eye-marks" as Sir G. WATT (1) published are, however, not reliable. To the author it seems impossible to formulate, as all commercial types are populations in the genetic sense, i e., mixtures, both outwardly and constitutionally widely heterogenous.

It is, notwithstanding possible to determine the *fitness* of a given population, by making a "population analysis", i. e., by counting in a certain nursery the hybrid plants, such with good branching the ill and badly developed plants. These characteristics at least can be expressed in numbers. Example, 50 plants taken as a sample: Flowering 10 %, diseased 4 %, badly diseased 0. Badly branched 44 %. Bad type 38 %. Badly developed 42 %. Average height 257 cm. (highest 370). Kept for seed garden 18 %.

The author gives in an appendix some results of this method of analysis

3) The author doubts if the choosing of plants with large, soft, light-green leaves can be the right way of selecting. For the next generation more stress should be laid on quantity and quality and resistance against disease. By means of an inquiry among the tea planters it was ascertained that many planters were acquainted with individual tea plants apparently free from *Helopeltis*, or with an extraordinary leaf producing capacity, and some planters had seen bushes resistant against root fungi or scarlet mite (*Brevipalpus*), but only in a few cases these bushes had been marked.

(1) G. WATT, Commercial product of India, 1908, p 209. Tea and the Tea plant. Journ. Roy Hort. Soc., XXXII, 1907, pag. 64.

The first stage of the investigation on immunity for *Helopeltis* should be to discover and to observe resistant plants; this is most reliable in searching only badly infected gardens, without, however, expecting to find plants absolutely free from disease. External factors producing immunity should be looked for, especially when the "immune" plants are found in little groups. The immune and very badly attacked plants should be marked and later on, grafts of resistant and non-resistant bushes should be carried to another locality, so as to make sure of the inherent factors, and breeding of immune types can be aimed at.

The leaf producing capacity was the object of an extensive series of observations carried out in 1920. It cannot be recognised by mere inspection, as the size of the plant frame is misleading. It has to be determined by a series of pluckings and to be expressed in amount of leaf produced per m² of plucking surface in each separate plant per annum. The best producers are to yield grafting material for a special seed garden which is to be compared with a "contra selection" of medium producers.

The selection of high quality tea does not seem to be worth while as the tea market is very conservative and big tea brokers do not like novelties.

The author describes however some selection work done in this direction (selection of dark-and light-green plants).

Import and investigation of new types is of small interest in tea selection. In Java, after the first importation of China seed about 1830 and Assam type about 1880, there has not been introduced any essential new type, with the exception perhaps of Manipur and Burma seed. The question is whether, in the case of tea, original planting material should be introduced or not. The possibilities in the way of selection are not exhausted, as far as concerns the tea stock present in Java, since selection has only recently been adopted. The author then reviews his studies of foreign literature and information received from Indo-China, Tonkin, Assam, Cochin-China, Burma, Siam, Calcutta, Singapore, Japan and China.

The last chapter of the report contains a programme for the Tjinjiruan gardens. When all the grafting work has been carried through, seed production is expected to begin (for 9 gardens) about 1928, and for 8 gardens about 1930. The plants selected on account of their leaf production capacity may yield seed between 1928 and 1933. Of course, in any case, the offspring must be carefully tested before any guarantee about the seed quality can be given, so that the terms mentioned above should be extended by about 5 years.

The volume contains two tables: a plate of the selection gardens, and a specification of the nurseries. Also 3 short appendices on the same questions, which had been published in other reviews; 7 photographs and a map of the seed-gardens of Tjinjiruan.

D. v. S.

634. Care of Tea-Seed Bearers.

AUCHINCLOSS, G. C. *The Tropical Agriculturist*, Vol. LX, No. 2, pp. 69-72, plates 2. Peradeniya, Ceylon, 1923.

The diminution of seed from tea-seed bearers, has recently been under investigation. From data obtained by the Department of Agri-

culture it is shown that in some cases the yield from trees 25-35 years old has been reduced by 50 % during the past ten years. As the plant lives for 75 years at least, this cannot be due to old-age.

Examination of seed-bearers shows that these are often over-crowded. Tea-plants are normally spaced $3\frac{1}{2}$ to $4\frac{1}{2}$ feet apart, which is sufficient when the plants are pruned to a height of two or three feet, but when allowed to grow for seed they reach a height of 15-20 feet, and need a space of not less than 12-15 feet square. In consequence, lateral growth is decreased and vertical growth increased, which causes the production of wood and also a diminished leaf-surface, on which the seed depends. Improvement may be effected by the removal of some of the weaker trees and by the pruning of non-productive wood, but it is doubtful whether abnormally tall trees would be able to spread laterally and so increase their leaf surface sufficiently.

When planting new areas it would be better to set the bearers at intervals of 12 feet, or 300 plants per acre. Attention should be paid to pruning, so as to produce a wide-spread head, as seed is borne chiefly on the periphery of the head. New and productive branches must be forced annually by cutting back the older laterals, and light and air must be admitted.

W. S. G.

635. Hop Investigations, Wye College, England.

SALMON, E S, and BURGESS, A H, *Journal of the Institute of Brewing*, Vol. XXIX, No 6, pp 400-410 London, 1923

The Institute of Brewing Research Scheme includes The Hop Nursery and its extension, under the charge of Prof. SALMON, allows for growing about 5000 varieties of hops. Many of these are worthless as commercial varieties, but are valuable for use as parents in cross-breeding. A record is kept of the seedlings as regards yield, brewing qualities, and resistance to disease, cuttings are taken from promising seedlings and tested on commercial lines, worthless plants being removed and their places taken by fresh seedlings.

From tests made in the greenhouse during 1922 no less than 348 new seedlings were found to be resistant to "mould", in most cases the resistance was complete. These seedlings were the result of crosses between the Golden Hop and certain of its seedlings, Bates Brewer, and a male hop from America, immune to "mould". Crosses were made between hybrid seedlings of American origin with the highest resin-content and selected male hops, some of which are immune to "mould".

At the Institute's Experimental Oast, Paddock Wood, thirteen series of experiments were carried out by A. H. BURGESS, with respect to the drying and sulphuring of hops, the following conditions being studied:—

- 1) Variation of amount and time of application of sulphur.
- 2) Variation of temperature.
- 3) Variation of air-speed.

1) *Variation of amount and time of application of sulphur.* — The amount and proportion of the resins, and the rate of drying was found to

be unaltered by the use of sulphur; hygroscopicity after drying was unaffected. The sulphured hops had a better colour than those unsulphured, and the best colour was obtained by burning the sulphur one hour after loading. A bad colour was caused by sulphuring just before the hops were finished.

2) *Variation of temperature.* — The ratio of hard to soft resins was unaltered by temperature in drying. Temperatures employed ranged from 122° F. to 212° F. Laboratory experiments show, however, that the soft resins are changed to hard by continued heating at 212° F.

It was found that hops are liable to become "reeked" if the initial temperature rises above 140° F., with an air current of 23 feet per minute.

3) *Variation of air speed.* — Air speeds varied between 13 and 64 feet per minute. No alteration was found in the amount or ratio of resins. With high speed air currents "reek" was caused, which was not the case when a lower speed was employed, the temperature being the same. The rate of drying appears to vary in proportion to the square roots of the air speeds employed. The residual drying power of the air was tested in all the experiments.

W. S. G.

636. Variations in the Scent of *Artemisia* as a Result of Grafting.

DANIEL. La variations des parfums sous l'influence du greffage. *Comptes Rendus des séances de l'Académie des Sciences*, Vol. 176, No. 15, pp 999-1001. Paris, 1923

In the course of a series of grafting experiments on aromatic plants, the author has noticed an interesting effect produced by the stock on the scion and *vice-versa*.

Thus, *Tenacetum* and *Artemisia*, when grafted on *Chrysanthemum frutescens*, become perennial, while their leaves decrease in size, and change more or less in shape and colour; on the other hand, the hardiness of the *Chrysanthemum* is increased.

With these morphological modifications, which are noticeable the first year, but become accentuated as the plant grows older, are associated alterations of scent and flavour that also increase with the age of the plant. A scion of *Artemisia absinthium* with very delicate, finely-divided leaves produced after three years, normally developed seeds capable of germination. In one of the seedlings raised from this seed the type characters had been distinctly modified by the effect of the grafting. The progeny of this plant was composed of individuals of very varied appearance, some much resembling the normal form, while others had finely divided leaves; the two extremes were connected by all the intermediate grades.

These phenomena prove that in *Artemisia*, as in many other species, symbiosis not only affects the grafted plant, but also its progeny both in a negative and positive manner.

The author is of opinion that research in this direction might afford results of great importance to the perfume industry.

G. A.

637. History and Status of Tobacco Culture in the United States.

GARNER, W. W. and MOSS, E. G. (Bureau of Plant Industry), and VOHE, H. S., WILKINSON, F. B., and STINE, O. C. (Bureau of Agricultural Economics). *United States Department of Agriculture, Year Book 1922*, pp. 395-468, figs. 28. Washington, 1923.

During the five-year period 1917-1921, the average area reserved for tobacco in the United States was 1 702 000 acres, the production 1 362 000 000 lb. and the average crop values was \$364 620 000. This output, which leads the world, includes a great diversity of types of tobacco. Kentucky, North Carolina and Virginia produce two-thirds of the total yield. The magnitude of manufacturing operations is indicated by the census returns. For comparative purposes a survey is made of the world production of tobacco followed by a review of the acreage, yield and production in the States. The marked increase in average production since 1879 is very striking viz. 350 000 000 lb. risen to 1 075 418 000 lb in 1921.

Historical development. — A report of the origin and gradual development of production and the changes occurring in various States. There has been a tendency throughout towards increased specialisation, and it has been gradually evolved that each set of types of tobacco can be produced only under certain special conditions of soil and climate and by adopting certain methods of growing and handling the crop. Each producing section supplies a definite type peculiarly suited for specific trade purposes.

CLASSIFICATION OF TYPES : a) Dark fire-cured and air-cured ; b) bright flue-cured ; c) cigar leaf ; d) white Burley. The present geographical distribution of these types is given, the development traced and the respective values are cited. Types b) c) and d) show a marked increase in production in recent years.

Factors influencing production.

1) *Systems of cropping* : A comparison is made between the systems adopted in different States and it is of interest to note that a well-balanced rotation — wheat, grass, clover, maize, tobacco, on heavy soils in Lancaster Pa. has given more regular and satisfactory results, including the evident value of winter feed for stock, than the highly intensive one-crop system on the lighter loams in Connecticut. The large yield in the second case is liable to decline at a certain period.

However, in order to maintain constant quality of tobacco from year to year, the prevailing practice in Maryland has been to grow two or more crops of tobacco on the land, chiefly without manure, and in some cases with a catch crop of wheat ; this is followed by maize after which the land remains fallow for some years. Under this system the yield has remained constant at approximately 700 lb. The system of continuous cropping and lying fallow has also been adopted in North Carolina, except that more fertilisers are used.

2) *Influence of soil and climate on quality* : The differences in quality are emphasised — and the deleterious effects of water-logged soils,

drought, frost etc. A report is given of investigations on the correlation of weather and yield in Ohio and Kentucky. The importance of fairly high temperatures and a moderate evenly distributed rainfall is generally recognised. The physical and chemical nature of the soil constitutes an important factor in leaf development: the cigar wrapper and binder types are grown on sandy loams with low water-holding capacity

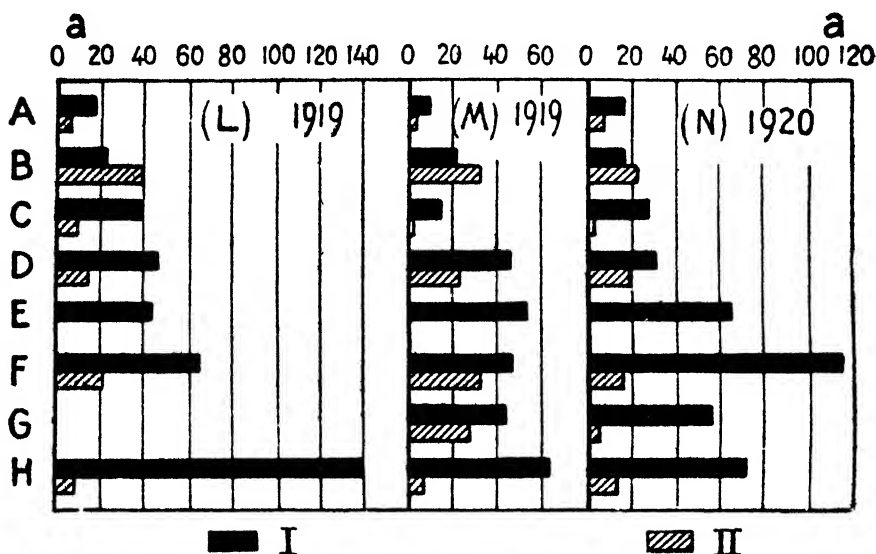


FIG 108 — Distribution of labour in growing of tobacco three producing districts.

- | | |
|--|--------------------------------------|
| A = Plant bed | F = Harvesting |
| B = Field preparation | G = Curing |
| C = Transplanting | H = Stripping and marketing |
| D = Cultivating | L = Kentucky Burley 1919. |
| E = Topping, worming, suckering and spraying | M = Kentucky Dark (Fire-cured 1919). |
| | N = Georgia 1920 Bright flue-cured. |

I = Man labour. — II = Horse labour.

(Connecticut, Quincey, Fla. Wisconsin) ; the cigar filler type on silt and clay loams (Pennsylvania) ; the Burley on fertile phosphatic limestone (Kentucky and S. Ohio) ; the dark fire-cured and air-cured on heavy silt and clay loam (Kentucky, Tennessee, Virginia) ; flue-cured on sandy loam (texture depending largely on subsoil) cigarette and granulated pipe smoking grades on light soils and low proportion of clay subsoil ; plugfiller and wrapper grades on heavy soil with more clay in subsoil.

The growing of high grade cigar wrapper leaf from Cuban seed under an artificial shade of cheese cloth or of States is an out-standing development.

Fertilisers. — The respective requirements of the various types is discussed.

Diseases and pests. — The most serious pests are the hornworms (*Pflegethontius quinquemaculata*) and *P. sexta*. — Others prevalent are *Chloridea virescens*, *Epitrix parvula*, *Lasioderma serricornis*. — Control methods are suggested. The "Wildfire" disease has been the cause of the most damage, although several others are reported. The bluemould has recently been introduced.

Cost of production. — The report includes details with reference to amount and distribution of labour, wages, land rents, costs of upkeep and maintenance of tobacco barns, and the comparative demands for the various types. A grouping of the records for different districts indicates an increase in yield corresponding with an increase in cost per acre and a decrease in cost per pound *e. g.* in Kentucky, farms producing from 600 to 1000 lb. per acre Burley tobacco showed an average cost of \$237 per acre and 30 cents per lb. while those yielding over 1500 lb. per acre showed a cost of \$330 per acre and 24 cents per pound. The fact that rank growth is often associated with poor quality and low returns should be remembered, and risks should consequently not be taken liable to sacrifice quality.

Financial basis. — Tobacco-growing has been found particularly suitable for the tenancy system, a method largely adopted in the Southern States; the tenants share of the crop is one-half or two-thirds, depending on the amount of fertiliser furnished by the landlord; the tenant in both cases is responsible for the labour, teams and machinery. — The crop is grown largely on a cash basis. — Under the share-rental system, the tenant usually receives half the value of the crop, and supplies the hand labour, the other items being divided between landlord and tenant. The self-operated method is limited only to certain northern-growing sections.

Marketing. — Three systems are in use: viz. Auction (Maryland, Virginia, Carolina, Georgia, Tennessee, Kentucky, S. Ohio, Indiana and Missouri); farm sales (cigar-leaf sections); co-operative marketing (general). Details are given as to the preparation for auction — and it is noted that the best marketable condition should contain 15 to 30 % moisture; excess of moisture should be avoided. A description is given of the warehouse auction methods: viz. the loose-leaf auction system, selling in packed form at public auction, and the closed-bid method *i. e.* samples displayed by the broker or commission merchant and bids collected for the same.

In farm selling, scarcely any attempt is made to classify tobacco with respect to quality and sales are made for a general average price. The contract method is largely practised.

The co-operative marketing includes three distinct lines:— co-operative packing, co-operative sales agencies and co-operative pooling. Each is described fully in the report. The most common form practised is the pooling or co-operative association system. From 50 to 75 % of the tobacco production in a particular section is determined upon as a goal, and the organisation does not proceed to act until this percentage has been pledged to the pool by individual farmers who sign contracts, agreeing to sell and deliver their entire crops for a certain fixed number of

years to the pool, which undertakes to sell the tobacco and present returns to the farmers after deduction of operating expenses. These associations are organised without capital stock; the tobacco received is sorted and graded and advance payments made accordingly. The subsequent sale to dealers or transmission for shipping purposes is entirely in the hands of the association.

Prices. — The data obtained is based on geographical division of types rather than on actual characteristics, owing to the absence of an uniform system of grading. A graph illustrates the rise and fall from 1865 to 1921. A survey is made of the locations of licensed warehouses and the licenseed inspectors, graders and weighers. The average farm price for the 1921 crop was about 89 % above pre-war figures.

Exports and Imports and Home Consumption. — The gradual increase in export trade during this last three centuries is traced — at the close of the war an excess of 750 000 000 lb. is given, the larger proportion being absorbed by Great Britain, the next in order of sequence being France, Italy and Germany (each 10 %), Netherlands (6 %), Spain (5 %), Australia and Canada (each 4 %), Belgium (3 %), China (2.5 %). As regards imports, these are limited to cigar wrapper leaf from Sumatra (average 6 000 000 lb. per annum), cigar filler and wrapper from Cuba (average 22 000 000 lb. per annum) tobaccos from Turkey (26 000 000 lb. approximately).

The per capita consumption of tobacco has steadily been on the increase for many years. This is evident from the figure which shows the home consumption and distribution of leaf in the manufacture of cigars, cigarettes, tobacco and snuff (1897-1921). It is notable that the increase is confined largely to cigarettes. Details are given as to the returns of the Commissioner of Internal Revenue. In 1921 as much as 60 billions of cigarettes were produced of which 8 ½ billions were exported. A comparison is made between the import and export trade of unmanufactured tobacco in the various countries concerned. The United States furnishes 41 % of the total. Full references are given relative to the import duties and internal revenue taxes.

The question has been raised as to the advisability of extending the tobacco crop to new territories. It appears that, taking into consideration the possibilities of production in excess of demand and the marked effects of soil and climate in each region on the type of leaf and the corresponding commercial demands, the exploitation of new territories is not practicable.

M. L. Y.

638 Tobacco Soils and Fertiliser Experiments.

OOSTHUIZEN, J. du P. (Manager, Experiment Station, Rustenburg), *Journal of the Department of Agriculture, Union of South Africa*, Vol. VII, No. 1, pp. 21-35, figs. 5, illustrations 14, Pretoria, 1923.

The results of the author's long series of experiments may be summarised as follows:— Climate and soil influence the character of the tobacco plant and are chiefly responsible for the distribution of the different types

of tobacco. The grade is more dependent on the cultural methods, the fertilisers, and the curing of the crop. Sandy and sandy loam soils generally produce bright tobacco and heavy clay soils dark coloured tobacco; an exception is the black, clay, norite soil but the high lime content of this soil is probably the cause of the bright leaf.

More attention should be given to the suitability of the soil type in each area; the mechanical composition seems to have greater influence on the type than the chemical composition. Lime is an important factor and was found to increase the yield on the acid soil of the Rustenburg Station, and the same result was obtained with phosphates. Phosphates, and to a lesser extent potash, increased the percentage of cigarette leaf, but nitrogen caused a decrease. Farmyard manure gave the biggest yield and the largest leaves, but lowered the percentage of cigarette leaf. A combination of farmyard manure and phosphates gave a high yield of good quality tobacco; the nitrogen content of a complete fertiliser for bright tobacco must not be high.

W. S. G.

639.^fPapaw and Papain.

THOMAS ELLIS, and BECKLEY V. A., Grootfontein School of Agriculture, Middleburg. *Journal of the Department of Agriculture*, Vol. IV., No. 4, Pretoria, South Africa, 1923.

The Papaw (*Carica papaya*) is propagated from seed, but good results have been obtained by grafting shoots from selected trees on to saplings. Trees may be planted at distances of 10 × 8 feet. Fruit should be ready for picking in about twelve months after planting the young seedling and the tree continues to be profitable for 4 or 5 years. The yield is about 30 fruits per annum, or a total of 150-200 per tree. The fruit weighs from 2 to 6 lb. The papaw contains papain, an enzyme, used as a drug in place of pepsin. Papain is sold as a soft, creamy powder at a price of about 3s. 2d. per oz.

The latex containing the papain is obtained from the fruits by scratching or cutting the rind with a bone or wooden knife, and collecting the juice in a glass or china vessel. The fruit must not be cut with a steel knife, nor the juice collected in a tin, or the papain will be darkened in colour and of little value. The latex is spread on unbleached linen stretched on frames and dried as rapidly as possible, but the temperature should not exceed 100°F., or the activity of the enzyme is decreased. While still warm the dried material may be ground in a small mill and packed in clean airtight tins, or preferably bottles.

W. S. G.

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A survey of the present position of the following crops in French Oceania: banana, coffee, cotton, vanilla.

R. D.

641. NORTON, L. J. An Economic Study of the Production of Canning Crops in New York. *Cornell University Agricultural Experiment Station, Bulletin* 412, pp. 1-82, tables 82. Ithaca, N. Y., 1922.

Report of investigations made in New York to obtain reliable information concerning the production and cost of the principal crops grown for canning factories, viz. peas, tomatoes, maize, and lima beans and to study some of the factors influencing the economical production of these crops.

M. L. Y.

642. SUTTON, G. L. (Director of Agriculture) and VANZETTI, F. (Wheat Experimentalist). Standard Wheat Varieties for the West Australian Wheat Belt. *Department of Agriculture, Western Australia, Bulletin* No. 111, pp. 4 + map. Perth, 1923.

A summary of the desirable characteristics of wheat varieties and descriptive large scale map showing the distribution in Western Australia of the early, midseason and late zones for planting. The four varieties mentioned are: Yandilla King, Nabawa, Gluyas Early, Florence, all of which are resistant to disease. A short description is given of each, including the two standard oat varieties, Algerian and Burts early.

M. L. Y.

643. SAMPIETRO, G. Ricerche sui rapporti fra la catalasi dei risi e la capacità germinativa (Investigations on Correlation between Catalase content and Germination Capacity of Rice). *Il Giornale di Riscoltura*. Year XIII, No. 9, pp. 133-141, figs. 1. Vercelli, 1923.

According to the results obtained, the author concludes that rice belongs to a species with a relatively high germination capacity and catalase content. Information at present available does not, however, yet allow of the practical application of this principle for the rapid estimation of the seed value.

F. D.

644. PONSARD J. Une ferme à pommes de terre. *Journal d'Agriculture pratique*, Year 87, No. 21, pp. 417-415. Paris, 1923.

Description of the system adopted on a farm near Paris where the potato is grown in a 2 year rotation with wheat and oats.

R. D.

645. CROUX, P. Les Asclepiades à tubercules à Madagascar. *Revue de Botanique appliquée et d'Agriculture Coloniale*, Year 3, No. 20, pp. 252-257. Paris, 1923.

A description of the 18 *Asclepias* spp. found in Madagascar. Although only a limited number of these tubers are used for food purposes at the present time, a wider knowledge of these plants should result in a more extended use of their nutritive material.

R. D.

646. TRABUT, L. Le Bersim ou Trèfle d'Alexandrie. *Revue de Botanique appliquée et d'Agriculture Coloniale*, Year 3, No. 21, pp. 333-342. Paris, 1923.

The Alexandrian Trefoil (*Trifolium Alexandrinum*) has been successfully used in rotation with cotton in the valley of the Middle-Niger. It is also common in North Africa where it has proved equally satisfactory. The article includes details as to botanical characteristics, varieties, cultivation, composition and utilisation.

R. D.

647. NEIDIG, R. E. and SNYDER, R. S. (Idaho Agricultural Experiment Station, University of Idaho), Sunflower investigations. *Journal of Agricultural Research*, Vol. XXIV, No. 9, pp. 769-780, tables 6. Washington, D. C., 1923 (1).

Discussion on the composition of sunflowers, time for cutting for silage purposes, distance apart for planting, and comparative results obtained in Idaho (U. S.).

M. L. Y.

648. NEIDIG, R. E. and SNYDER, R. S. (Idaho Agricultural Experiment Station). Sweet Clover Investigations. *Journal of Agricultural Research*, Vol. XXIV, No. 9, pp. 795-799. Washington, D. C., 1923.

Report of investigations made in order to test the value of *Melilotus alba* and *M. officinalis* as silage crop substitutes on land not suitable for maize or sunflower in Idaho (U. S.). The report includes detailed analyses of the sweet clover varieties and the silage obtained.

M. L. Y.

649. FERRARA, A. and TRITTA, G. A. Composizione chimica dei fieni naturali della Cirenaica (Chemical Composition of Wild Fodder Plants in Cyrenaica). *L'Agricoltura coloniale*, Year XXVII, No. 8, pp. 294-303. Florence, 1923.

Analyses of 26 species of fodder plants, part of a collection sent from Cyrenaica to the "Istituto Agricolo Coloniale Italiano" for botanical and chemical analysis. A detailed table shows the diversity of types found in the different parts of Cyrenaica and a comparison is made with species common to southern Italy and in natural pastures. In general there is a distinct similarity between the three groups.

F. D.

650. DELANOUE (Conseiller agricole à la Direction Générale de l'Agriculture). Le Mûrier fourrage d'été (The Mulberry Tree as a Summer Forage Plant). Regence de Tunis. *Bulletin de la Direction Générale de l'Agriculture*, Year 27, No. 112, pp. 103-114. Tunis, 1923.

The author after calling attention to the importance of silk production in Tunisia, notes that the mulberry tree should also serve a useful purpose

(1) See R. 1923, No. 379. (Ed.).

in Northern Africa as a fodder plant. Without irrigation and at a critical period of the year, the summer and autumn, it supplies an abundant green forage which is much appreciated by stock. The article includes details as to methods of cultivation, yield, composition and utilisation in the different countries. R. D.

651. TISON, L. (Chef du Laboratoire de Chimie de Boma) *Le Dolichos bulbosus*. *Bulle'in Agricole du Congo Belge*. Vol. XIV, No. 1, pp. 61-64, 1923.

General review of the forage value of *Dolichos bulbosus* L. (= *Pachyrhizus angulatus*) characteristics and distribution; followed by a detailed analysis of tubers obtained in the Belgian Congo compared in nutritive value with potato, carrot, radish, beet, turnip, Jerusalem artichoke. Reference is made as to the best time for collecting tubers.

M. L. Y.

652. TRABUT L. Le coton à la Ferme expérimentale de "Ferme Blanche", années 1920-21-22 (Cotton at the Experimental Farm "Ferme Blanche". Years 1920-21-22). *Bulletin Agricole de l'Algérie-Tunisie-Maroc*, Year, 29, No. 4, p. 61. Algiers, 1923.

Crop yields and economic value of the two cotton varieties "Yuma" and "Pima", selections from the Egyptian "Mitafifi". R. D.

653. Pour l'Olivier. *Compte rendu des Travaux du V^{ème} Congrès International d'Oléiculture*. Marrakech et Rabat, pp. 338 tables and plates. Paris, 1923.

In this work, which is illustrated by numerous photographs, a study is made of 30 reports drawn up by specialists. The following questions are dealt with: the situation of olive-cultivation and of the olive-product industries in Spain, France, Algeria, Morocco, Tunisia and Italy, and the improvements to be introduced; the means of reconstructing old olive-yards and turning to account wild olive-trees; the parasites of the olive and their control; preserved olives; pressing olive pulp; the extraction of olive oil from the skins; the treatment of olive pomace, etc. This book is both scientific and practical and will be very useful to olive-growers, olive-pressers, manufacturers and dealers, for it contains much hitherto unpublished information. R. D.

654. AUCHINLECK, G. G. West African Oil Palm and its Products. *Department of Agriculture, Ceylon*, Bulletin No. 62, pp. 1-18, plates 5. Peradeniya, Colombo, 1923.

A survey of the world's oil palm trade, followed by a description of the oil, fruits and yield in Ceylon compared with the fruits and oil content on the Gold Coast and West Africa. The author discusses also the habit of the palm, the range of climate and soil, methods of cultivation, diseases, extraction of oil, and factory processes. M. L. Y.

655. SAMPSON H. C. *The Coconut Palm: the Science and Practice of Coconut Cultivation*, pp. 262. Plates 40, Price 31s. 6d. Published by John Bale Sons and Daniellsson Ltd., Great Titchfield St., London, 1923.

The « Coconut Palm », by H. C. SAMPSON, C. I. E. late Director of the Department of Agriculture, Madras, should prove of especial value to all those engaged in the cultivation of the coconut, as the author is both a scientist and an experienced planter.

The book is divided into three sections, the first of which describes the root, stem, crown, leaf, flower and seed of the palm, great attention being paid to the root, which in this plant is of peculiar importance. The second section on management of plantations is thoroughly practical in treatment.

The various stages of the planting and harvesting of the crop, the contingencies and difficulties arising under tropical conditions and the procedure necessary to ensure success are described in detail.

The third part deals with the different coconut products and their preparation for market.

The 40 illustrations are of high value, and the coloured diagrammatic plates showing the composition of the plant and the nut at different stages of growth form a striking and original feature of the work.

W. G. S.

656. CREVOST, C. H. (Inspecteur en Chef ds Services Commerciaux) and LEMARIE C. (Directeur adjoint des Services Economiques d'Indochine), *Les matières grasses de l'Indochine. (Oil Plants of Indo-China) Bulletin des Matières Grasses*, No. 3 and 4, pp. 90-151. Marseilles, 1923.

A list of the principal oils produced in Indo-China, giving local and scientific names, botanical and cultural details, and commercial value of those derived from the following plants:— Amoor (*Amoor gigantea*), (*Arachis Arachis hypogea*), Brasileto (*Caesalpinia bonducella*), Candlenut (*Aleurites* sp.), Camellia (*Thea Sasanqua*), Calophyllum (*Calophyllum Inophyllum*), Carilla (*Momordica cochinchinensis*), Castor oil (*Ricinus communis*), Chestnut (*Aesculus* sp.), Cotton (*Gossypium* spp.), Cynometra (*Cynometra ramiflora*), Evodia (*Evodia fraxinifolia*), Hemp (*Cannabis sativa*), Hickory (*Carya tonkinensis*), Hodgsonia (*Hodgsonia heteroclita*), Horseradish (*Moringa pterygosperma*), Indian almond (*Terminalia Catappa*), Kapok (*Eriodendron anfractuosum*) and *Bombax malabaricum*), Litsaea (*Litsaea citrata*), " May chim han " (?) " May hin " (?), Mangosteen (*Garcinia tonkinensis*), Macassa Oil (*Schleichera trijuga*), Parinarium (*Parinarium anamense*), Perilla (*Perilla ocymoides*), Physic nut (*Jatropha curcas*), pine (*Pinus Khasya*), robinia (*Pongamia glabra*), Sesame (*Sesamum indicum*), Shaddock (*Citrus decumana*), Soya (*Soya max*).

R. D.

657. PINCHING, H. C. General Principles of Economic Rubber Planting. *The Tropical Agriculturist*, Vol. LX, No. 1, pp. 3-13, Peradinya, Ceylon, 1923.

The author considers the subject under the following headings:—Selection of land, return on capital, number of trees per acre, square, avenue and quinquex planting, weeding, and thinning out. W. S. G.

658. *The Columbian Review* (Rubber Possibilities in Columbia), Vol. II, No. 3, p. 96. New York, 1923.

The article draws attention to the rise in price of rubber and the threatened scarcity, due largely to the great demand caused by the development of the automobile industry, together with the export duties imposed by Great Britain on East Indian rubber. In consequence, American business men are considering the exploitation of South America, which offers enormous possibilities as regards rubber. Next to Brazil, Columbia is the richest in rubber trees; the principal rubber areas lie near the Amazon River, and in the Choco Mountains, both of which are conveniently situated for transport of the product to the Atlantic or Pacific Coasts. W. S. G.

659. HEIM F. and CHENEVEAU C Valeur industrielle de 2 caoutchoucs de plantations d'Annam *Bulletin de l'Agence Générale des Colonies*, Year 16, No. 181, pp. 8-10. Paris, 1923.

Description of the two varieties of rubber of Cam-Son (Nha-Trang) and Dak-Joppa (qui-Nhon), both derived from *Hevea latex*. R. D.

660. Sugar in Siam. *The Record*, Vol. 1, No. 3, pp. 6-17, Bangkok, 1922.

In this monograph a brief historical sketch is given of the sugar industry in Siam, followed by descriptions of the varieties of cane and palm grown in the country, methods of cultivation and sugar production, and trade statistics. W. S. G.

661. Tea Growing and Manufacture in the Dutch East Indies. *The Spice Mill*, Vol. XLVI, No. 9, pp. 1768-1774, plates 3. New York, N. Y., 1923.

General review of the tea industry and cultivation in the Dutch East Indies, chiefly in Java, including details as to withering, rolling, fermentation, drying, sorting and packing and data concerning area planted and export trade, with descriptive illustrations. M. L. Y.

662. PULLIAM, W. E. Dominican Cacao, *Bulletin of the Pan American Union*, Vol. LVII, No. 3, pp. 245-252, plates 3. Washington, D. C., 1923.

Description of the development of cacao cultivation in the Dominican Republic and statistics concerning export 1920-1921. M. L. Y.

663. STOCKBERGER, W. W. (Bureau of Plant Industry), Growing and Curing Hops in the United States *U. S. Department of Agriculture, Farmer's Bulletin* No. 1304, pp. 1-36, figs. 20. Washington, D. C., 1922.

Although the general methods employed in hop production are well known, the author devotes his attention especially to certain practical principles of great importance to successful hop growing, and gives also a brief general outline of hop culture, including propagation, planting, cultivation, pruning, trellis and other systems of training, packing, curing baling and marketing.

In the United States, the climatic conditions on the Pacific Coast States appear to be specially favorable to this crop, where abundant early rainfall is followed by warm, dry weather as the plant approaches maturity. The yield varies widely according to locality (in California up to 2 200 lb. per acre; in Washington, 1 200 to 2 000 lb.; in Oregon 1 000 to 1 600 lb. and in New York 800 to 1 500 lb.).

M. L. Y.

664. POTTS, G. (Professor of Botany, Grey University College, Bloemfontein). The Pepper Tree (*Schinus molle* L.) as a Cause of Hay Fever in South Africa. *The South African Journal of Science*, Vol. XIX, pp. 146-195. Tables 21 + charts, bibliography Johannesburg, Dec. 1922

Inoculation tests have shown that hay fever patients react to pepper tree pollen and it has been concluded that this tree is responsible for the epidemic in South Africa. The article reviews the climatic conditions in Bloemfontein relative to epidemics in general, and the effect of weather on the drying and dispersal of pollen. The pollen grain is discussed from the standpoint of formation, pollination, distribution of pepper trees and comparative toxicity of the leaves and flowers. Preventive methods are given including the importance of the removal of the male tree. Other possible causes of hay fever are mentioned.

M. L. Y.

665. MASON S. C. (Office of Crop Physiology and Breeding Investigations, Bureau of Plant Industry). The Saidy Date of Egypt and Adaptability to Commercial Culture in the United States. *United States Department of Agriculture, Bulletin* No. 1125, pp. 35, figs. 4, bibliography. Washington, D. C., 1923.

The author reviews the principal commercial varieties of dates, and the character and detailed history of the Libyan Saidy date palm. The facility of propagation, productiveness, packing and keeping qualities and superior quality render this variety of special commercial value. The fact that this date will mature without loss with the relative humidity of the ripening season at from 68 to 75 %, suggests the suitability of the Saidy date for wide areas in California, and Arizona where other imported varieties (e. g. Deglet Noor) will not succeed.

M. L. Y.

666. D'OLIVEIRA XAVIER, J., Notas sobre a cultura do castanheiro no Concelho de Vila de Rei. (The Cultivation of the Chestnut in the Concelho de Vila de Rei). *Broteria, Serie de Vulgarização scientifica*, XX, Part VI, pp. 251-253. Braga, 1923.

Historical information respecting the cultivation of the chestnut in the Concelho de Vila de Rei (Beira Baixa, Portugal), together with some observations on the advisability of introducing the Japanese chestnut ("Shiga Kouri"), as a means of preventing Ink Disease. This tree has been acclimatised in Portugal and has proved an excellent stock upon which to graft the European variety of chestnut. F. D.

667. HICKEL, R. Le sapin de Douglas. (The Douglas Fir). *Comptes Rendus des sciences de l'Académie d'Agriculture de France*, No. 13. pp. 375-378. Paris, 1923.

The author draws attention to the care required in the introduction of foreign species of forest trees. In one case, however, a certain species, namely the Douglas Fir (*Pseudotsuga Douglasii*) has proved its superiority over similar indigenous species in several parts of France and the article describes in detail the properties of this tree (1). R. D.

668. WILLIAMS, C. (Chemist, School of Agriculture, Cedara, Natal). The Black Wattle Industry in South Africa. *The Tropical Agriculturist*, Vol. LX, No. 1, pp. 19-35. Peradinya, Ceylon, 1923.

This report gives a botanical description of the black wattle, the early history of the industry, suitable localities for production, area grown and yield, methods of cultivation, cost of production, grading of bark, diseases and pests, and by-products. The article is followed by a short report on the wattle bark industry in East Africa. W. S. G.

669. SWEET, J. M. *Artocarpus hirsuta* as an Underwood for Teak. *The Indian Forester*, Vol. XI, IX, No. 5, pp. 248-251. Allahabad, 1923.

Report of successful attempts made in the teak plantations in Nilambur (Madras) with *Artocarpus hirsuta* as an underwood, following up the satisfactory results obtained in Travancore, which demonstrate the effective prevention of epicormic branches of teak, by adopting this method. M. L. Y.

670. GREEN, A. W., Shelter Belts and Hedges at Ruakura, New Zealand. *New Zealand Journal of Agriculture*, Vol. XXVI, No. 3, pp. 133-139; pp. 5. Wellington, 1923.

Report of twenty years experience of wind-swept areas in New Zealand and a list of trees and shrubs which have given satisfactory results as ornamental and useful shelter hedges round the farm. M. L. Y.

(1) See R. 1922, No. 1319. (Ed.).

671. SPILLMAN, W. J. Distribution of Types of Farming in the United States. *United States Department of Agriculture. Farmers' Bulletin No. 1289*, pp. 1-30, figs. 5. Washington, 1923.

The author has studied the factors that control the distribution of types of agriculture, and in this Bulletin gives an analysis of the farming in the United States, and the reasons which are now causing agriculturists to consider the advisability of changing their crops and methods of farming.

W. S. G.

672. ORWIN C. S. (Director of the Institute for Research in Agricultural Economics, Oxford). *Farm Costing and Accounts*. Price 2/- (Successful Farming Series), Benn Brothers, Ltd., London.

This is a practical manual on farm accounting by a high authority on the subject.

W. S. G.

LIVE STOCK AND BREEDING.

SYNTHETIC ARTICLES.

673. Range Plants poisonous to Stock.

I. — FLEMING, C. E., MILLER, M. R., and VAWTER, L. R. The Spring Rabbit Brush (*Tetradymia glabrata*) A Range plant poisonous to Sheep. *University of Nevada Agricultural Experiment Station, Bulletin No. 104*, pp. 29, tables VII, figs. II. Carson City, Nevada, 1922.

II. — IDEM. The Low Larkspur (*Delphinium Andersoni*) Plant of the Spring Range, poisonous to Cattle. *Ibid.*, No. 105, pp. 22, tables, figs. 8. Carson City, 1923.

III. — DWIGHT MARSH, C., CLAWSON, A. B. and COUCH, J. F. (Pathological Division, Bureau of Animal Industry). Greasewood as a Poisonous Plant. *U. S. Department of Agriculture, Circular 279*, pp. 1-4, figs. 2. Washington, W. C., 1923.

IV. — PANISSET, M. L. (Prof. à l'Ecole d'Alfort). Cattre Poisoning by *Sorghum exiguum* (1). Empoisonnement des bovidés par le sorgho à balais. *La Vie agricole et rural*, Year 12, No. 29, p. 46. Paris, 1923.

I. — *Tetradymia glabrata* is a shrub common to the foot-hills in Nevada, U. S., and several other Western States. Observations have led to the conclusion that, although sheep do not appear to like the taste of this plant,

(1) See R. 1919, Nos. 1079, 1104, 1922, Nos. 700, 728. (Ed.)

they will often eat the tender new growth in the spring and early summer if other feed is scarce.

Feeding tests were made at the Nevada Agricultural Experiment Station, and results indicate that sheep can eat nearly 2 lb. without apparent harm; the poison has, however an accumulative, deleterious effect, finally causing severe sickness and death. The active poisonous principle has not yet been discovered; analyses prove that neither the essential oil of the scent, nor the large percentage of potash salts in the buds and shoots are responsible for the poisonous effect. The first symptoms observed are restlessness, refusal of food, twitching of the muscles, and eventual collapse. Attempts to treat this condition have so far proved unsuccessful. Losses have been confined to sheep; there is apparently no danger of poison with cattle or horses.

II — *Delphinium Andersoni* is common in eastern Oregon, California and Nevada, and is poisonous to cattle but not to sheep. The plant is found usually on sandy loams, and at a time of year when other vegetation is scanty. Experimental feedings have shown that it takes from 20-25 lb. of leaves and flowers to cause any fatal results with a normal animal. The plant appears to be more toxic before flowering than later. The first symptoms of poisoning is the sudden collapse, and little time is left for treatment. Consequently, methods of prevention are advised as regards overstocking and overgrazing.

III. — Description of the toxic effects produced by *Sarcobatus vermiculatus* ("Greasewood"), on stock, especially on sheep a Chenopodiaceae which is common in the States of Washington, Montana, California, Texas, on alkali soils. It appears that poison is due to sodium and potassium oxalates in the plant. This observation is of special interest, as it is usually considered that the poisonous principles of plants are of an alkaloidal or glucose nature. Soluble salts of calcium could be used as an antidote, but for a poison which affects animals so seriously there is probably no antidote which could be of practical use under range conditions.

IV. — *Sorghum exiguum*. — In Sèvre-Niortaise (France), a herd of cows showed signs of severe poisoning as a result of eating green sorghum which had been fed in the form of forage. The symptoms became so serious that some of the animals died within a few hours and the post mortem examination showed violent inflammation of the rumen the mucous lining of which had been removed in places where it had come in contact with fragments of the forage, as if it had been subjected to the action of some caustic substance. Two rabbits that had been given a few small stalks of sorghum in their rations died in a very short time. The toxicity of this sorghum would appear to be due to the presence of prussic acid in the form of a glucoside which is set free by the action of the digestive juices. This glucoside apparently occurs only in young plants whose development has been abnormal, for sorghums are as a rule, perfectly innocuous. This hypothesis is confirmed by the fact that Dr. SAUSSEAU, Director of the Veterinary Services of Deux-Sèvres, reported on the occasion of the above-mentioned poisoning of cattle that the sorghum used was badly developed

owing to the drought. A similar result was obtained by using sugar sorghum that had grown abnormally on account of adverse weather conditions.
M. L. Y.

674. The Early Detection of Pregnancy.

I. — SCHMIDT. (Tierzuchinstitut der Universität Göttingen). Über neuere Versuche zur frühzeitigen Feststellung der Trächtigkeit. *Journal für Landwirtschaft*, Vol. 71, Part I, pp. 1-8, Berlin, 1923.

II. — WENDT E. (Assistant, Göttingen). Die frühzeitige Trächtigkeitsnachweise bei Schweinen mittels interferometrischen Methode. *Ibidem*, pp. 9-13.

III. — SAX A. (Assistant, Göttingen). Von welchem Zeitpunkt ab lässt sich die vorhandene Trächtigkeit bei Schweinen vermittelst der Interferometrischen Methode erkennen? *Ibidem*, pp. 14-15.

I. NEW METHODS OF DETERMINING THE EARLY STAGES OF PREGNANCY. — Of the many methods for the detection of the beginning of pregnancy that have been brought forward as being a simplification of Abderhalden's seriological method, the most worthy of notice is HIRSCH's "interferometric method". This is carried out by means of an instrument called an interferometer made by the firm of ZEISS of Jena. The method is an optical one based on the principle that when the serum of a pregnant animal acts upon the tissues of the placenta, the insoluble albumin in the serum is decomposed by fermentive action into soluble peptones. The decomposition products pass into solution, thus raising the concentration of the serum which can be estimated by means of the interferometer, the value obtained being compared with that registered in the case of a similar sample of the same serum into which no placenta has been introduced. Preparations of placenta from different species of animal are supplied in a convenient form by the Pharmaceutical Institute of L. W. GANS, Aktiengesellschaft Obersel i. T.

When applied to human subjects, the interferometric system gives accurate results.

It has been widely used for animals, excellent results having been obtained with mares and sows, but since the properties of the placenta, and metabolism vary in the different species, it is necessary in every case to study whether the method can be usefully applied before finally adopting it.

As regards mares, it has been proved by results obtained from 110 animals that pregnancy can be satisfactorily detected by the interferometric method as early as 14 days after fertilisation. (GERMANN Über den frühzeitigen Trächtigkeitsnachweis bei Pferden nach der Interferometrischen Methode, *Landwirtschaftliche Jahrbücher*, Berlin, Parey, 1922).

II. EARLY DETERMINATION OF PREGNANCY IN SOWS BY THE INTERFEROMETRIC METHOD. — *Method*. From the results of his experiments on a hundred sows, the author concludes that: 1) a negative reaction is a certain

proof of the absence of pregnancy provided the animal had been served at least 4 weeks previously ; 2) a positive reaction probably points to pregnancy, but is not an infallible criterion, for positive results are sometimes found in the case of non-pregnant sows, if they are in a pathological condition that allows non-specific ferments, usually digestive ferments, to find their way into the blood ; 3) it is often possible to detect pregnancy in sows as soon as 8 days after they have been served but the protective ferments do not appear with any fixed regularity during the first 4 weeks after fertilisation : subsequent to that time, however, pregnancy can always be demonstrated.

III. HOW SOON IS IT POSSIBLE TO DETECT PREGNANCY IN SOWS BY MEANS OF THE INTERFEROMETRIC SYSTEM. — This article describes the continuation of the previous work. From experiments made with 61 serums taken from healthy, unmated sows and 59 serums obtained from sows that had been served, the author concludes that his investigations, like those of WENDT, have proved that with careful handling and proper material, few mistakes are made in diagnosing pregnancy in sows by means of the interferometric method, and that it is possible to detect pregnancy 2 or 3 weeks after fertilisation. F. D.

675. Variations in Milk Yield (1).

I. — WILSON, J. The Variations of Milk Yield with the Cow's Age and the Length of the Lactation Period. *The Scientific Proceedings of the Royal Dublin Society*, Vol. XVIII, New Series, Nos. 11-13, pp. 97-104, figs. 2. Dublin, 1922.

II. — HAMMOND, J. (Institute of Animal Nutrition, School of Agriculture, Cambridge). Some Factors affecting Milk Yield. *The Journal of Agricultural Science*, Vol. XIII, Pt. 1, pp. 74-119, figs. 18, tables 19, bibliography. London, 1923.

III. — BROODY, S., RAGSDALE, A. C., TURNER, C. W. (Department of Dairy Husbandry, Missouri) Rate of Decline of Milk Secretion with the Advance of the Period of Lactation. *The Journal of General Physiology*, Vol. V, No. 4, pp. 441-444, figs. 1. Baltimore, 1923.

I. — *Variations of milk yield with the cow's age and length of the lactation period.* — The author reviews in succession : 1) the records obtained from cows exhibited at the London Dairy Show, during the 10-12 years prior to 1909 ; 2) scale constructed by GAVIN with reference to records kept in Lord Rayleigh's dairy herds in Essex (England) ; 3) scales constructed by PEARL, MINER and TOCHER based on records published by the Scottish Milk Records Committee, relative to milk yields of Ayrshire cattle 1903-1912. The author considers that scales based upon the Ayrshire records cannot represent the normal daily rise in milk yield, and bases his conclusions on the two foregoing records :—

(1) Suppose that at 8 years old the cow yields approximately 67-80-90-95-98 to 100, for 4-5-6-7 year old cows.

(1) See R. 1922, No. 611 (Ed.)

(2) Insufficient information is as yet available for 2-year-old yields but those whose age averages about $2\frac{1}{2}$ years should correspond to yields at 8-years-old, 50 to 100.

(3) For yields of cows over 8-years-old, records are also insufficient.

As regards milk yield during the lactation period, as the length of lactation varies, a scale is necessary to indicate how much should be added or subtracted to bring about a normal yield, i. e. successive calving after 12 months according to the Ayrshire reports for 1920, a lactation period of 11 months, indicates an average of 38 weeks milk yield; a period of 12-13-14-15 months corresponds to 40-44-45-47 weeks yield respectively. GAVIN found that the yields of cows which are in calf, begin to decrease (below those of cows which are not calving) about 24 weeks before the next calves are born. For a lactation period of 11 months the yields should be about 20 gallons below that for normal lactation, and for 13-14-15 months lactations, about 35, 65 and 90 gallons above that for normal lactation. The Ayrshire reports of 1913, 1919, and 1920 agree largely with the foregoing data.

II. — *Some factors affecting milk yield.* — The following factors were studied: 1) month of the year in which the cow calves; 2) length of the interval between calvings; 3) age, as measured by lactations; 4) dry period i. e. period of rest preceding the lactation under consideration.

Naturally, other factors also have an influence on the yield such as feeding, methods of treatment, methods of milking, weather, etc. In the hope of eliminating these influences as far as possible, the investigation was restricted to a single Milk Recording Society at Penrith (Cumberland and Westmoreland); all the cows were Shorthorns chiefly non-pedigree, and raised under similar conditions.

Effect of month of calving. — The information collected includes: 1) mean total yields of cows calving in different months (see Fig. I) as indicated by the curve; 2) mean length of lactation of cows calving in different months; 3) increase and decrease in yield in different months. The first curve indicates an increase in yield towards the end of May, the second an increase in milk yield from May or September followed by a decrease; the third, a decrease less marked in winter than in summer and autumn.

The decrease from June onwards is attributed to the fact that the pastures become dry and parched and the grass hard and fibrous, and in October when the fall is still more rapid, to the fact that the cow is adapting herself to winter conditions. This explains why as a general rule the yields are higher for cows calving in November. They are already used to winter conditions, — and they give a steady flow of milk which does not fall to any considerable extent until the following June or July. On the contrary a cow calving just before this winter change, yields less, probably due to the fact that the change occurs at a time when she is actively withdrawing from her body substances to supply the milk flow.

The period during which the milk falls rapidly (July) comes earlier in the lactation in November-February calvers, with the result that

yields are lowered. March calvers give their maximum when turned out to graze, so that they yield more during the first part of their lactation than the February calvers. It has been claimed that a good estimate of a cow's yield during lactation may be obtained by multiplying her highest daily yield by a given factor; the author's results do not, however, support this possibility.

Length of interval between successive calvings. — "Service period". This is on the average short in summer and long in winter (See Fig. 2). A study has been made as to the correlation between total lactation yield and service period. This is by no means a linear relation, the yield rising at first more rapidly and then more slowly as the interval is lengthened,

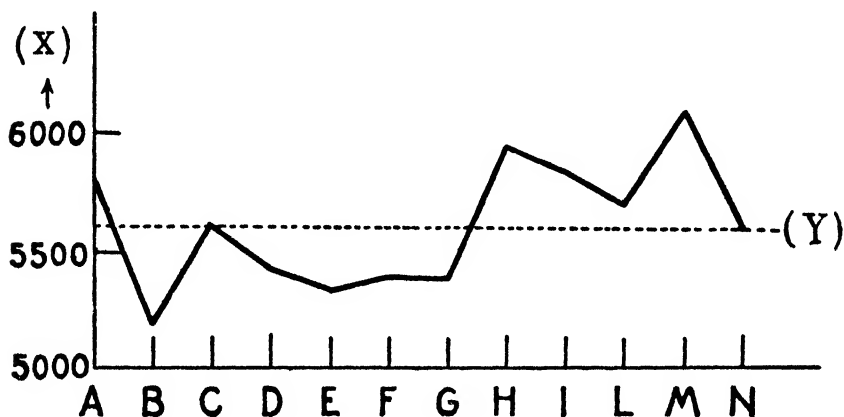


FIG 109. — Mean total yields of cows calving in different months

X = Yield in lb.

Y = Mean = 5607 lb.

Letters = Successive months of the year (January-December)

and apparently tending to a limit. This suggested that a curve might be drawn to calculate the effect of service period on total yield. As an example, a normal service of 100 days was selected as a standard. From the curve the mean total corresponding to this period = 5760 lb.

It will be noted that the yield may vary by as much as $\pm 30\%$ according to length of service period, due to the close relation between the length of this period and the length of lactation. As a result the authors endeavoured to ascertain the effect of foetal growth on the possible lowering of milk yield. The lower level is maintained for about 20 weeks when the cows begin definitely to dry off. The slight decrease immediately after service is probably due to natural cause resulting from the growth of the uterus and its contents. The definite drying off at 20 weeks after service may be attributed to internal secretions from the reproductive organs.

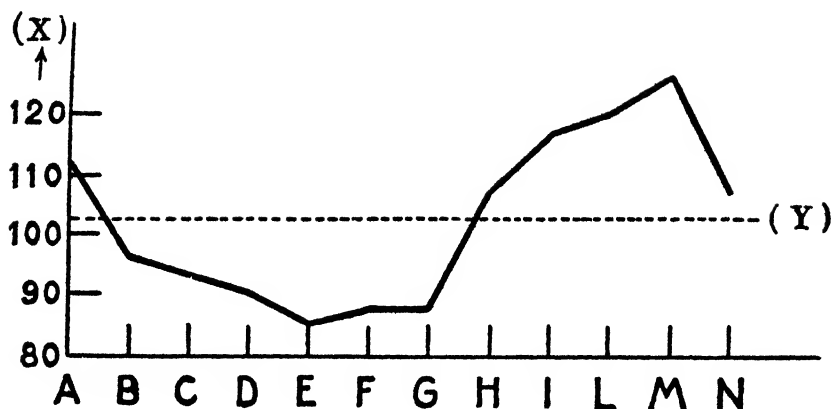


FIG. 110. — Mean service period of cows calving in different months

X = Service Period in days.

Y = Mean = 102.3 day.

Letters indicate months January-December.

TABLE I. — Corrections to total yield for service period.
(Standard service period = 100 days).

Service Period	Mean total from cruvé	Percentage correction to apply
days	lb.	%
0-19	4427	+ 30
20-39	4770	+ 21
40-59	5084	+ 13
60-79	5372	+ 7
80-99	5635	+ 2
100-119	5876	— 2
120-139	6097	— 6
140-159	6300	— 9
160-179	6485	— 11
180-199	6655	— 13
200-219	6830	— 15
220-239	6952	— 17
240-259	7083	— 19
260-279	7202	— 20
280-299	7311	— 21
300-319	7411	— 22
320-339	7503	— 23
340-359	7587	— 24
360-379	7664	— 25
380-399	7734	— 26
400-419	7799	— 26
420-439	7858	— 27
440-459	7912	— 27
460-479	7961	— 28
480-499	8007	— 28

Age. — Firstly a study was made as to effect of age on the length of the service periods, which are evidently shorter with age until after the third or fourth calf, when an increase in length has been noted and after the sixth or seventh calf it is longer than after the first. Consequently no accurate measures have been obtainable as to the variation which a cow's yield undergoes as she becomes older, without first correcting her total yield for the corresponding service periods. Accordingly, the authors first corrected all totals for the month of calving and for the service period; then the means of the first and second lactation totals of all cows were found and the difference expressed as a percentage of the first lactation mean total. The percentage of the second and third lactation was calculated in the same way. The results for the first six lactations are shown in the following table:

TABLE II.

Lactation period	Mean table (corrected)	Rise or fall %
1st lactation	4909	+ 10.5 % \pm 1.8 %
2nd "	5425	
	5746	+ 10.7 % \pm 2.0 %
3rd "	6359	
	6595	+ 0.2 % \pm 2.2 %
4th "	6610	
	6655	+ 6.5 % \pm 2.7 %
5th "	7088	
	7782	- 5.4 %
6th "	7364	

Taking an average 1st lactation yield as 4 909 lb., the 2nd yield is calculated as 110.5 % of this; the 3rd is 122.2 % of the first; the 4th 122.5 % and the 5th 130.3 %. The corrections for age to estimate 5th lactation period is given as 30 % (1st lactation); 18 % (2nd); 10 % (3rd), 4 % (4th).

The mean totals obtained for different months of calving are considerably influenced by the ages of cows as well as by the service period. The authors calculated in this way the total mean yield for all the cows (5 607 lb.); and the monthly mean yield, corrected for service period and age, and separate corrections as regards month of calving and service period: — the corrections for month of calving are expressed as follows: January —; February +10 %; March +2 %; April +3 %; May

[675]

+2 %; June and July —; August —8 %; September —4 %; October —1 %; November —6 %; December +2 %.

The rest, or dry period, is not effected by age, hence corrections are not considered necessary.

Length of dry period. — To obtain an accurate measure of the effect of the dry period on the subsequent yield, corrections were necessary for the totals for service period, age (a short dry period generally corresponds with a long service period); month of calving. Subsequent yields were then expressed as a \pm percentage of the 1st lactation yield, with a view so establishing the correlation between these percentages and the length of the dry periods. The mean percentage yield corresponding to a dry period of 0-39 days, was 100.0, for 40-79 days, 110.9, and 114.2 for 80-119 days. It appears, therefore, that a cow's yield is considerably lowered by a very short dry period, but not greatly increased by a very long period. The mean length of the dry period of all lactations was 85 days; there is, however, some evidence of a further rise associated with dry periods of over 120 days, correction to apply = -2 %; 40-79 days, +2.5 %; 0-39 days +13 %.

The problem was also attacked by another method: the totals given by the same cow after dry periods falling in the above categories were compared. The mean of all the yields was found and the variation of the cow's several totals expressed as \pm percentage of this individual mean.

Conclusions. — The figures obtained from a lactation by applying the above corrections is an estimate of the cow's yield, under normal conditions when at her prime (at the 5th or 6th calf), that is to say, calving in January, June or July (i. e. mean months), with a period of 100 days between successive calvings; with an 85 days period of rest before calving.

The variation is allowed for by applying corrections to the extent of 20 % of the original value; 3 % for service period and month of calving; 15 % for age; 2 % for dry period. It should be noted, however, that this does not give a good idea of the relative value of these corrections as cows tend to have all long or all short service periods and this applies also to dry periods. Cows also, generally calve about the same time each year. In this way it is considered probable that the average maximum variations are due to four factors, e. g. for a 7000 lb cow.: service period 4074 lb.; age 1615 lb.; month of calving 1245 lb.; dry period 948 lb. Fig. III gives an idea of a definite approach to the real milk producing capacity of cows, after making corrections. The distribution of the variation of corrected totals is much more regular than that of the uncorrected, and the number of lactations shows an increase of 27.3 %.

The authors review, in closing, the experiments made by other investigators.

III — *Decline of milk secretion with the advance of the lactation period.*

— In order to understand the nature of the decline of milk secretion with the advance of the period of lactation, the authors have compared the curves of the decline of production of milk and the period of lactation found in

the Holstein, Jersey, Guernsey and scrub cows, with a curve based on a formula expressing the course of certain chemical reactions, and found them to be in close agreement. The decline of milk secretion may thus be

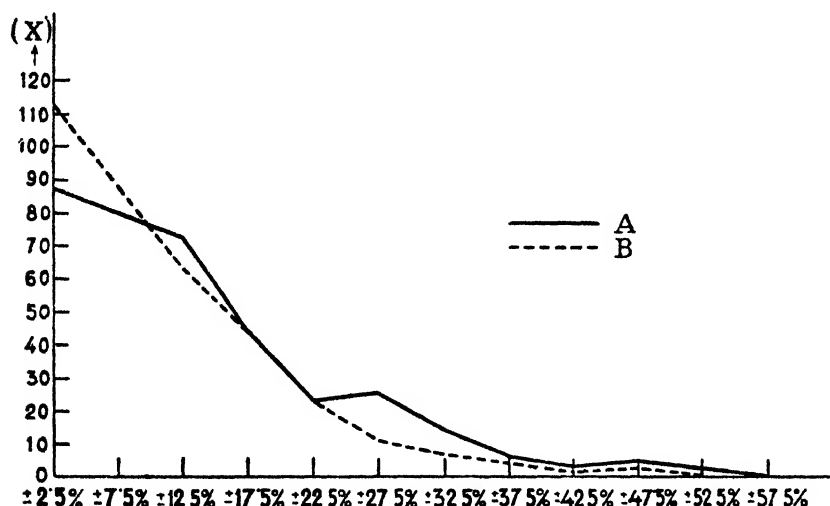


FIG. 111. — Frequency curve of percentage deviation of totals from individual means.

X = Frequency Y = Percentage deviation (mid values of intervals).
 ————— A (uncorrected totals).
 - - - - - B (corrected totals)

represented by the equation of a monomolecular chemical reaction, which is constant throughout the lactation period. This suggests that milk secretion is limited by a chemical reaction and that the speed of the lactation process is controlled by the concentration of a limiting substance.
 F. S.

676. Egg Production of the Various Periods of the Year and Classification of Laying Hens (1).

I — HARRIS J. A. and LEWIS, H. R. (Station for Experimental Evolution, Cold Spring Harbor, Long Island, New York) The Winter Cycle in the Fowl. *Science*, Vol. LVI, No. 1443, pp. 230-231. Utica, N. Y. 1922.

II. — HARRIS, J. A. and GODDALE, H. D. (Massachusetts Agricultural Experimental Station, Amherst, Mass.) The Correlation between the Egg Production of the various Periods of the Year in the Rhode Island Red Breed of Domestic Fowl. *Genetics*, Vol. 7, No. 5, pp. 446-465, diag. 7, bibliography. Brooklyn, New York, 1922.

(1) See R. 1919, No 960 (Ed)

III. — PAYNE, L. F. Culling Farm Poultry. *Agricultural Experiment Station Kansas State Agricultural College, Department of Poultry Husbandry Circular* 93, pp. 1-33, figs. 23, bibliography. Manhattan (Kansas), 1922.

IV. — CALDERON, B. Le classement des poules pondeuses d'après leurs caractères anatomiques et physiologiques. *La Revue Avicole*, 33rd Year, No. 1, pp. 9-11, figs. 2. Paris, 1923.

I. CORRELATION BETWEEN THE EGG PRODUCTION OF THE VARIOUS PERIODS OF THE YEAR IN THE WHITE LEGHORN BREED OF DOMESTIC FOWL. — Part of a series of investigations in connection with egg records and laying breeds.

The idea of the superimposition of a Mendelian factor or factors determining the egg production of the "winter cycle" upon the factors determining the egg production of the normal or reproductive cycle has become recognised as an explanation of the inheritance of fecundity in the domestic fowl. In recent years there has been much scepticism among breeders as to the truth of this hypothesis. Definite evidence for or against is difficult to obtain.

Some light may be thrown upon the problems by the determination of the correlations between the egg records of the various "cycles" in the first and second laying year. If the birds of a flock differ fundamentally among themselves, by reason of the presence or absence from the zygotes from which they developed in Mendelian genes or factors determining their winter egg production, it would be logical to expect that the highest interannual correlation would be that of the winter period. This should be true under the theory stated unless the further assumption be made that genes or factors which determine egg production during the "winter cycle" of the first laying year have no influence in determining production during the "winter cycle" of the second laying year.

The authors have, therefore, studied all possible correlations between the total egg records of the "cycles" of the first and second year for a series of 443 White Leghorn birds for which complete records for the first two laying years are available. These correlations are shown in the accompanying table. The conventional limits of these cycles are as follows: spring, March to May; summer, June to August; autumn, September to October; winter, November to February.

Correlations indicate that for all the four periods considered, there is a higher correlation between the records of homologous periods than between those which are not homologous; for example, the correlation between the "winter cycle" first and second years is 0.3225 ± 0.0301 ; between the "winter cycle" first year and the spring cycle, first year, $+0.0680 \pm 0.0335$; between the "winter cycle" first year and the spring cycle, second year $+0.1177 \pm 0.0332$ etc. They show also that the correlation between the winter periods of the first and second year is the lowest of any of the four correlations between the productions of homologous periods ($+0.3293 \pm 0.0300$; $+0.4272 \pm 0.0275$; $+0.5545 \pm 0.0233$ for winter cycle", summer and autumn). The difference be-

tween the winter-winter correlation and the spring-spring correlation is not great, but the differences between the winter-winter correlation and the summer-summer and autumn-autumn coefficients are more substantial, the latter being 2.57 and 6.10, as large as their probable error.

As far as this form of evidence relates to the problem, it indicates that in the White Leghorn at least, there is no evidence of special factors which distinguish the "winter cycle" from any other period of the year.

II. CORRELATION BETWEEN THE EGG PRODUCTION OF THE PERIODS OF THE YEAR IN THE RHODE ISLAND RED BREED OF FOWL. — Results of a statistical analysis of the monthly egg records for the pullet year of 1958 Rhode Island Red^s at the Massachusetts Agricultural Experiment Station, Amherst (Mass.). This study forms part of a series of investigations on the more important laying breeds (1).

The problems under consideration and the results obtained are summarised as follows.

1) *Correlation between monthly record and total annual production.* — Coefficients are shown to have a material positive value ranging from 0.325 to 0.634 in the 36 determinations made. The average values were: $r = 0.5094$ (1915-16); $r = 0.5479$ (1916-17); $r = 0.5363$ (1917-18).

The production in the case of the White Leghorn may be calculated on the same basis. The regression for the annual total egg production is roughly speaking linear. The constants indicate therefore that the production of any individual months should furnish a reasonably satisfactory basis for the prediction of egg production for one month, using equations of the type computed and shown to be effective in the case of White Leghorns.

2) *Correlation between the record of individual months and of the other eleven months in the same year.* — These values are lower than those deduced for the relationship between monthly production and annual production. This is clearly shown by the statistics.

Apparently the correlation between the individual months of the year and the annual total is not due primarily to the inclusion of the record of the individual month in the annual total.

3) *Correlation between the annual production and the deviation of the productions of the individual months from their probable values.* — These correlations refer to two year periods and to the combined period 1917-19. The average is as follows: $r = 0.196$ (1915-16) $r = 0.244$ (1916-17); $r = 0.228$ (1912-19). The coefficients for the different permutations vary considerably; for instance a correlation of 0.918 exists between the 1915-16, and the 1916-17 coefficients. Two systems of coefficients appear to exist:

1) The correlation between the egg production of the individual months tends to become smaller as the interval between the months considered is widened.

2) There is a more intimate correlation between the egg production of the autumn and winter months at the beginning and end of the contest year, than between the egg production of these months and that

of the spring and summer months. These two laws of the distribution of the magnitude of the correlations are to some extent mutually obscure.

These conclusions are in general agreement with those already drawn for White Leghorns.

III. CULLING FARM POULTRY. — The use of trap-nests is the only sure means to ascertain the individual egg-production of fowls, but these nests entail a good deal of labour and cost both money and time, hence they are not every practical for a farm, although by their means it has been possible to determine the correlation between various degrees of production and certain characters, thus enabling the poultry-breeder to distinguish with a fair amount of accuracy, if not with the certainty gained by the employment of trap-nests, the good, average, and bad layers of his flock. He has, however, no guarantee for the future egg-production of the hens, except in so far as it may be predicted from their past performance. No reliable method has yet been devised for the estimation of the egg-yield of young pullets that have not begun to lay.

Classification must therefore commence with egg-production. In the United States, the hens are examined once a month from about the middle of July to the middle of October. In July and August, the bad layers are eliminated, while in September and October, the best individuals are selected for breeding purposes. Amongst the good layers, it is necessary to distinguish between the hens that will only lay a large number of eggs the first season and those birds capable of a sustained effort for several years.

Present production. — Information as to present production can be obtained by examining the cloaca, the bones of the pubis, the comb, wattles, and ear-lobes. The cloaca of a laying hen is large, moist and dilated with a tendency to assume an ovoid shape. The lower border is flat and the upper one is merged into the surrounding issues (See Plate XXXIII, Fig. 112-A). The cloaca of a hen that does not lay, or is a bad layer, is on the other hand, small, contracted and dry (See Fig. 112-B). In a laying hen, the bones of the pubis are at least two finger breadths apart, which is the maximum distance found in a hen that does not lay. The comb is one of the best characters for distinguishing the layers from the non-layers in the poultry-yard. The wattles and ear-lobes are also useful, but not to the same extent. When the egg-producing apparatus is developing and is in activity, the blood circulates more freely in the comb, wattles and ear-lobes, so that they become larger, more glossy and appear fuller. As soon as egg-production slackens, these appendages change their appearance, and when egg-laying ceases the comb becomes small, shrivelled and dry; further it is generally covered with a white film and is cold, which shows that the blood circulates very slowly.

Duration of laying period. — The duration of the laying period can be estimated to a large extent by the colour of the hens skin and the beginning of moulting. The yellow pigment (xanthophyll) seen in the beak and legs of a hen is the same as that found in the yolk of the egg. When a hen does not lay, the yellow pigment is localised in the body tissues and

is frequently met with in the cloaca, the eyelids, ear-lobes (if these are usually white), beak and legs of the bird, but as soon as the hen begins laying, this colouring matter is absorbed in egg-formation and leaves the parts of the body where it was visible before, so that these become whitish.

When a hen with yellow skin commences laying, the xanthophyll leaves the cloaca from which it disappears at the end of a few days. The turn of the ear-lobes comes next, they lose their cream-colour as does also the beak. The colour gradually leaves the commissure of the beaks, the tip of the beak being the last place from which it disappears. After 4 to 6 weeks of egg-laying, the yellow colour has entirely disappeared from the beak and the legs are the last to lose their pigment. This decoloration begins in front and finishes beneath the feathers, behind the tibio-tarsal joint. The process is not complete until after the 4th or 5th month of egg-production. The change in colour is affected by food, the size and age of the bird, the texture of its skin, its vitality and the extent of the pigmented area in the individual and the family to which the hen belongs. The decoloration is more important for classification during the period preceding April 1. The following breeds are classified according to the rapidity with which the yellow pigment disappears. Leghorn, Wyandotte, Plymouth Rock and Rhode Island Red.

In white plumaged fowls and also in some others, the duration of egg-laying can also be estimated from the condition of their feathers in summer and autumn. As long as a hen is laying regularly she keeps her old feathers, but when she ceases laying owing to her becoming broody, or ill, the moult sets in and extends from the neck to the back, wings, and other parts of the body. The neck of even the best layer may at any time become bare of feathers, but the moult does not extend over the rest of the body until egg-laying has ceased. Thus, it may be said that the later a hen begins to moult, the longer her productive period lasts and the more eggs she will lay, whereas a fowl that begins to moult early has probably made a poor record.

Intensity of production. — In order to be a good layer, a hen must not only produce eggs for many weeks, but must lay 5 to 6 eggs a week.

The intensity of production can be gauged from the capacity of the body, state of the abdomen and quality of the skin. (See Plate XXXIII, Fig. 113). It appears that a hen in full egg-laying should have an ovary and oviduct about 20 times as large as those of a hen that is not laying; the appetite of the laying bird is also larger and its digestive apparatus is more developed.

Capacity for egg-laying is shown by the distance between the front of the breast-bone and the centre of the back, by the space between the posterior end of the breast-bone and the bones of the pubis, by the length and width of the back and by the length and width of the breast-bone. These dimensions are more or less fixed in the adult hen, except that the posterior part of the breast-bone rises, or sinks. A space of 4 to 5 finger-breadths between this portion of the breast-bone and the

bones of the pubis generally indicates a good layer. The position of the breast-bone in relation to the line of the back may also be taken into account, and is judged by placing one hand on the back and the other on the breast-bone. This test is only applicable to laying fowls; the capacity of pullets that have not reached the period of egg-production must be estimated from other measurements.

The abdomen of a good layer is not only full and capacious, but should also be soft and flexible; the fat should not be hard. The capacity of the abdomen depends upon the size of the hen and the length of her breast-bone; usually, a long breast-bone is preferred. The bones of the pubis should be thin and supple, they are only thick and covered with hard fat in the case of birds producing few eggs. In addition, good layers have a soft, oily, thin skin.

The reproductive organs of a broody hen rapidly shrink in size, the bird loses its appetite and the cloaca, as well as the whole abdominal region, tends to contract. At this time, while retaining the characters of birds that have laid much, broody hens have an abdomen of average size, and the cloaca, although fairly large, is dry and is surrounded by large folds. The brows are thick and over-hanging, the head, comb and wattle are dull in colour.

At other times besides the egg-laying period, it is possible to distinguish laying hens of the "productive type", which type is characterised by the great depth between the front part of the breast-bone and the centre of the back; the deep thighs narrowing off into a wedge-shape; the long, straight back of equal width to the base of the tail; the broad pelvis and wide expanded breast.

The author, after mentioning the various causes that may affect the above-mentioned characters and thus mislead the breeder who is using them as a basis of classification, passes on to examine the cock, which must be vigorous and should possess a short, well-curved beak, a large, deep comb and bright, quick, prominent eyes. Its comb, cheeks and wattles ought to be of a fine red, the neck short, arched and well-set on the shoulders. The legs of medium length are straight and the tibio-tarsal joints are far apart. The breast is prominent, the shoulders far apart; there should be a great width between the middle of the back and the centre of the breast-bone. Contrary to what is required in the hen, in the well-bred cock there should be little distance between the bones of the pubis and the abdomen ought to be small. It is not advisable to choose early-maturing cockerels, since their skeleton is often weak, and they are frequently under-sized. Breeding from too young cocks tends to decrease the size of the progeny and may even affect the size of the eggs.

After some experience, the breeder who bases his selection on these data and on present production should attain 95-100 % of accuracy. If the birds are classified according to their annual production estimated from the records of former years, the degree of accuracy will only be 70 or 75 %.



FIG. 112. The ventral abdomen of living hen (V) and of a nonliving hen (P)



FIG. 113. The contracted abdomen and contracted deeply wrinkled vent of a hen 9 days after going broody



FIG. 114. Skeletons of the cull (left) and the high producer (right). When judging body type of good hens that are *in lay*, emphasis is placed on the size of the triangle (left) and that of the triangle (right) representing hens in *full production*. When a hen is *in lay*, the right base of the triangle (right) moves toward the left base so this distance varies with egg production. The angular points of the triangle (left) remain the same whether the hen is *in lay* or not.



FIG. 115. Hipbone seen from above and behind, without the tail vertebrae *a b c d*, lumbar and sacral vertebrae *e f*, extremities of ischium *g h*, extremities of pubis.

IV. THE CLASSIFICATION OF LAYING HENS ACCORDING TO THEIR ANATOMICAL AND PHYSIOLOGICAL CHARACTERS. — The measurement of the distance between the bones is an uncertain method of estimating abdominal capacity, for the pelvic bones yield easily to the pressure of the fingers and further, these bones may themselves vary in width. The pelvis of the adult birds is formed by the fusion of the ilium, ischium and pubis; it does not assume its definitive shape until the hen is ready to lay, therefore any measurements taken before that time can give no accurate information. The size and weight of the bird depend to a large extent upon the development of the pelvis, but its weight is more a function of the width than of the length of the pelvis. In a fat hen, the dimensions *i-j* and *e-f* are relatively very large, as are also *a-b* and *c-d* (Plate XXXIII, Fig. 115). The dimensions *i-j* can easily be estimated in a live fowl and give a good idea of the width of the pelvis, even before the bird begins to lay. With the approach of the laying season the apertures *e-f* and *g-h* become greatly enlarged, but it must be noted that the space *g-h* is relatively smaller in a large than in a small hen, especially if the small hen lays large eggs. In large hens, the sternum is wider and its lateral processes (apophyses) are further apart and give more width to the abdomen. These processes are very flexible, and the whole sternum moves easily in an upward direction under the pressure of the intestines. The author has also noticed that the characters distinguishing a good layer are more noticeable in a small hen than in a large one.

On comparing the pelvic bones of the two birds, he has come to the following conclusions.

- 1) The narrow skeleton of the small hen may indicate a poor layer, or a prolific layer of small-sized eggs.
- 2) A hen with a fine pelvis may be a good, or a bad, layer.
- 3) A hen with an average pelvis may lay 250 eggs during its first year of laying.

The indications are that selection, directed to increasing the abdominal capacity, would control the tendency of prolific layers to produce small eggs.

F. S.

General.

677. The Licking Habit and its Connection with Forage Composition (1).

KÖNIG J. and KARST H. (Landwirtschaftliche Versuchstation, Münster i. W.) Der Einfluss des Bodens und der Düngung auf die Zusammensetzung der Pflanzen. Ein Beitrag zur Geschichte der Lecksucht. *Die landwirtschaftlichen Versuchs-Stationen*, Vol. C, Part VI, pp. 269-315. Berlin, 1923.

The authors have carried out researches at the Agricultural Experiment Station of Münster (Germany) to ascertain the effect of soils and fertilisers upon plant composition and the connection between the composition of forage and the licking habit in calves.

(1) See R. 1921, No. 1132. (Ed.)

It is now generally admitted that the cause of this habit is to be sought in forage and especially in hay, therefore the authors have compared the composition of the various crops in localities where this disease was unknown with that of the same crops in localities where the licking habit was prevalent (Hollich, near Burgsteinfurt i. W.).

No important difference was discovered in the ordinary forages (rye, oats, straw, potatoes, beets) grown on the various soils, but there was a considerable difference in the composition of the hay. In the sand-free dry matter of the hay samples from Hollich the following percentages were found: crude fibre 33.11 to 36.49; silicic acid 0.44 to 0.645; phosphates 0.0307 to 0.046; soda 0.091 to 0.107, ratio of phosphoric acid to calcium oxide 100:155 to 100:187; as against 29.58 to 31.22 — 1.87 to 2.65 — 0.0426 to 0.0562 — 0.277 to 0.589 — 100:203 to 100.249 respectively for hays from three localities where the licking habit had never been observed.

OSTERTAG and ZUNTZ's first suggestion that there was some toxic principle present in the hay causing licking disease, can be rejected, since the disease has been proved to be accompanied by affections of the bony framework due to a lack of bone-forming substances in the food supplied to the animals.

SOXHLET and Fr. FLEISCHMANN have assumed that an insufficiency of phosphates is the cause of the disease. The analyses of our authors have, it is true, shown the hay of infected districts to contain less phosphates than that of good farms where the disease has never made its appearance, but the differences in the phosphate content were very small.

IBELE attributes the licking habit to an insufficiency of soda in the hay (which may be accompanied by an increase in the potash content), and to a wrong proportion between sulphuric acid and lime, leading to loss of lime in the animal organism. The Hollich hay did, indeed, contain little soda and a defective sulphuric acid:lime ratio, but this does not appear to account entirely for the disease which cannot be cured by merely giving the animals kitchen salt and calcium carbonate, whereas linseed cake has proved an efficient remedy.

In HOLY's opinion, licking is caused by the presence in the hay of too large proportions of silicified, crude fibre which injures the mucous membrane of the intestine thus decreasing the utilisation not only of the hay, but also of the other foods. This hypothesis may, however, be rejected, for although the Hollich hay contained more crude fibre than the hays from the other districts, its silica content was lower.

E. RITTER attributed the licking habit observed in Switzerland among dairy cows to the low alkalinity of the hay and its higher phosphoric acid content as compared with the lime. This, however, cannot in itself be the cause of the disease, for although the Hollich hay contained more potash and soda than good hays, the alkalinity of its ash is about the same.

M. POPP has found that the ash of the blood of animals attacked by the licking disease is richer in potash and poorer in soda than the

ash of healthy animals. The authors thinking a similar difference might exist in the milk examined it, but without any conclusive results. From the data they collected, it is, however, certain that the offspring of cows fed on abnormal hay are born with a predisposition to the licking disease.

Hays from acid meadows, which include those suspected of being the cause of the licking disease, have an unpleasant odour due to the presence of a special volatile acid; the concentration of hydrogen ions in the aqueous solution of these hays is higher than in that of wholesome hay. J. KÖNIG considers this property and the higher content of crude fibre to be the causes of the low availability and poor nutritive value of hay from acid meadows. This would account for the fact that these hays when treated with steam are more readily eaten by cattle, and according to OSTERTAG and ZUNTZ are perfectly harmless. Thus, the reason of licking disease making its appearance as a result of the cattle being fed upon a certain quality of hay is not the insufficiency, or excess, of any single constituent, but is certainly to be found in the co-operation of several injurious factors. In all the cases hitherto reported, the suspected hay came from new soil, or acid, peaty land, poor in bacterial flora owing to a more or less one-sided application of mineral fertilisers. After some years of cultivation, such soils become normal.

Remedial measures: treat suspected hay with steam, and make all the grass of suspected meadows into sweet silage, further, give a complementary ration of cake and a little molasses feed, or else salt and lime.

As regards the effect upon the composition of cultivated plants by the character of the soil, it is chiefly noticeable in the alkalinity of the ash, but its degree varies greatly with the species. This was again confirmed by the work of the authors.

In cereals, the grain is negatively alkaline, while the straw is positively alkaline. The degree of negative alkalinity of the grain varies in the different species, but remains fairly constant within the same species, therefore it is not affected by the soil, or the application of fertilisers. Straw, on the other hand, is positively alkaline when the soil is alkaline, or has been limed.

It has often been proved that in cereals, as well as in roots and forage, there exists a correlation between the amount of potash and of phosphoric acid present in the ash, so that the alkalinity of the ash is highest when the potash content is greatest, and the ratio between potash and phosphoric acid is widest. F. D.

678. *Lamium amplexicaule* and *Malva parviflora* Cause of Staggers or Shivers of Livestock in New South Wales.

DODD, S (Lecturer in Veterinary Pathology and Bacteriology, University of Sydney) and HENRY, M (Government Veterinary Surgeon). *Department of Agriculture, New South Wales, Science Bulletin* No. 23, pp. 1-24. Sydney, 1923.

Investigations made with sheep affected by "staggers" or "shivers", caused by the enzootic disease occurring also amongst horses, cattle and

sheep in certain parts of New South Wales viz. the alluvial areas of the basin of the Namoi River, and of the Gwydir River. This disease is characterised by the intoxication of the central nervous system, which has been observed to be caused by ingestion of certain plants, especially *Malva parviflora* and *Lamium amplexicaule*. No definite structural alterations have been noted histologically, likely to incite permanent damage to nerve tissues; this is evident from the fact that sheep removed from pastures where these plants are known to be growing, have been reported to recover rapidly and completely.

It has not been definitely shown whether the toxic principle exists actually in the plant itself or is due to fungi or other parasites in the plants. It should be noted, however, that at the young green stage the toxin is not fixed and a few days after the plant has been cut, the toxin has largely disappeared. As the plant matures, the toxin becomes fixed, and is more virulent in the case of *Lamium amplexicaule* than with *Malva parviflora*.

Sheep are very subject to attack and it is considered probable that the toxic principle is transmitted in the mother's milk without the mother showing any symptom of "staggers".

Attention is drawn to a letter in the *American Veterinary Review*, Vol. XXX, p 106 (1906) by S. H. HESTER, Veterinary Surgeon, Santa Barbara, California, headed "Injurious Effects of Malva Plant", which appears to deal with a condition identical to that studied by the authors.

G. Tg.

679. The Dog As a Carrier of *Boophilus microplus*.

CASSAMAGNAGHI O El perro come vector de *Boophilus microplus* *Revista de la Asociación rural del Uruguay*, Year LII, No. 3, pp 59-61. Montevideo, 1923.

The author describes four experiments made with dogs. The animals were a fox-terrier, a short-haired "galgo", a large long-haired, curly-coated mongrel pointer, and a long-haired Maltese terrier. The conclusions he reached were as follows: 1) dogs act as hosts, not only to *Amblyomma maculatum* but also to *Boophilus microplus* which lives upon them and thrives; 2) the female *Boophilus* that develops upon the dog lays fertile eggs; 3) the larvae when they hatch out attach themselves to cattle on which animals they probably accomplish their biological cycle; 4) short-haired dogs are able to get rid of these parasites which can only establish themselves on dogs with long thick coats.

J. P. C.

680. Haemoglobinuria of Cattle.

SANZ, B, and SKIBA, O. La hemoglobinuria bovina. *Boletín de la Sociedad nacional de agricultura*, Vol. LIV, No. 7, pp. 430-433, tables 1. Santiago, Chili, 1923.

The author during the investigations made as to the cause of haemoglobinuria of cattle have succeeded in reproducing this disease in pigeons and guinea pigs. Intramuscular injections were made with various sam-

ples of urine from diseased foals. Results obtained were definite; the animals died on the sixth day.

During the autopsy of the infected animals, microscopic examination was made. The anaerobic cultures obtained with minute portions of liver showed the presence of a bacteria, type *Clostridium Welchi*, and other organisms (*coli* and *subtilis*). Further injections and cultures gave a colony of *Cl. Welchi* which when injected into a calf produced the disease immediately, with fatal consequences.

From these experiments the authors have concluded that haemoglobinuria is an infectious disease connected with the digestive organs and caused by a bacteria of the type *Clostridium Welchi*, which attacks the liver. In addition, the disease may be induced by intrahypatic inoculation.

J. P. C.

681. Artificial Feeding and Lack of Vitamines.

HOET, J (Laboratoire de Chimie Physiologique de l'Université de Louvain) Étude de l'alimentation artificielle chez le pigeon et de la déficience en vitamines *The Biochemical Journal*, Vol XVII, No. 2, pp 220-229, graphs 2, tables 1, bibliography Cambridge.

Experimental tests were made with pigeons fed on a ration composed of 18 parts casein + 60 rice + 4 McCollum salts + 3 filter paper + 10 margarine + 5 butter, with a supplement of yeast or other water soluble vitamine to replace the deficiency in vitamine B. This ration was sufficient to maintain normal health and the reproduction processes and cross-breeding with the offspring. The dry yeast supplement acted as a preventative against polyneuritis and to conserve the normal weight. The usual minimum dose for this purpose lies between 0.80 and 0.90 gm. for pigeons of 350-400 gm. weight. For pigeons in a state of collapse, with convulsions, a daily dose of 0.60 gm. of yeast is sufficient to relieve these nervous attacks after a few hours and subsequently to induce an increase in weight. The egg-laying level is, however, not so easily regulated and never attains the normal.

As regards liposoluble vitamines, the authors were faced: firstly with the difficulty in purifying the feeds, and secondly the slowness with which the animals responded to the deficiency in vitamine A. The experiments made with pigeons indicated that for poultry, in any case for adults, the liposoluble vitamine is unnecessary. This is directly opposed to the results obtained with chickens tested under similar conditions by HART, HALPIN and STEENBOCK (1922), EMMETT and PEACOCK (1922) and PLIMMER and ROSEDALE (1922) and others. The authors undertook further tests using for ration, 18 parts casein + 60 starch + 15 groundnut oil + 4 salts + 3 filter paper. The oil was solidified by hydrogenation (hardened fat), and was lacking in vitamine. Control tests were made with four young rats and symptoms of xerophthalmia were observed shortly after.

G. Tg.

682 The Feeding Value of Oat Straw.

COLLINS, S H (Agricultural Department, Armstrong College) *The Journal of the Ministry of Agriculture*, Vol XXIX, No 11, pp. 993-997, bibliography London, 1923

Experiments have been carried out since 1920 at Armstrong College, Newcastle-upon Tyne (England), with the twofold object of determining the effect of natural causes in producing variations, in the feeding value of oats, and of discovering the conditions necessary for the production of straw with a high nutritive value

Starch is the principal carbohydrate found in straw and all the nitrogenous substances present are of great importance, since the proportion of non-albuminoid nitrogenous matters is very low.

An analysis of the straw harvested in 1919, 1920 and 1921, gave some indication of the effect of fertilisers on the feeding value of oat-straw. When a large amount of organic nitrogenous manure was used, the albuminoid content of the straw was 1 27 % higher than if very little of this fertiliser had been applied or none at all, and 1 30 % higher than that obtained with a top-dressing of sulphate of ammonia. As a rule, oat straw with a 1 28 % higher albuminoid content is obtained from the use of a large quantity of an organic nitrogenous manure than by the application of any other fertiliser.

On the other hand, it is probable that organic nitrogenous fertilisers decrease the amount of levulose in oat-straw, and that from the point of view of sugar production, sulphate of ammonia is superior to organic nitrogen. By ploughing up an old field of thick clover, or applying a liberal dressing of stable-manure, the albuminoid or meat-forming substances in straw can be increased until they are 1 5 times higher than in the case of straw grown on badly cultivated land, but the proportion is reversed as regards the sugar content.

The author has also studied the connection between the variations in the albuminoid content of the straw and geographical position, and states that the albuminoid substances increase the further north the oat-crop is cultivated. This may be explained to some extent by the fact that, as the vegetative period is shorter, there is less time for the grain to abstract as large an amount of nutritive substances from the straw as in the south, but it is equally possible that the difference in rainfall may have some influence

In order to have a high sugar content, it is necessary to have fine weather at harvest time. When it is dry, the straw loses little of its sugar, but in wet weather, the sugar content is greatly reduced.

The albuminoid and sugar percentages varied from 1.1 % — 8 %, and from 0.3 % — 9.7 % respectively, that is to say, good quality oat-straw may have a higher feeding value than poor hay.

F. S.

683. Digestion Experiments with Bullocks fed on Paddy Straw.

WARTH, F J (Agricultural Research Institute, Pusa) *The Agricultural Journal of India*, Vol XVIII, Pt. V, pp. 456-464, tables 5 Calcutta, 1923.

Experiments made at Pusa (India) with two bullocks fed for 10 months on a ration consisting of paddy straw combined with a small amount of concentrates. No green food was given. The average live weights of the animals were in the proportion of 1 : 1.40 and the food given, 1 : 1.25.

The average digestion coefficients obtained from the two animals indicated that the animals were able to utilise the food to a very satisfactory extent. Of the organic matter, nearly 60 % was digested. Figures as a whole show that small differences in the nitrogen content of the paddy straw may be expected to produce distinct differences in feeding results. The nutritive ratio of digested food averaged 1 : 16.2. The figures relative to the digestion of nitrogen in relation to the straw composition (which was found to contain an average of 0.5 % nitrogen) confirms the above statement. It appears that from 12-15 gm. is the minimum quantity required to maintain a nitrogen balance in animals of from 500-700 lb. weight. The greatest amount which the animals were able to assimilate from the straw was 4 gm. and the addition of a concentrate is therefore essential. By using good straw the concentrate, may, however, be reduced by one-half.

M. L. Y

684. White versus Yellow Maize; Relative Feeding Values.

BLACKSHAW, G N (Chief Chemist, Department of Agriculture, Rhodesia). *The Rhodesian Agricultural Journal*, Vol XX, No 2, pp 178-182 and Bulletin No. 455 Salisbury, April 1923

For some time the Rhodesian Government Agriculturist has recommended the cultivation of white dent maize in preference to the yellow dent varieties and flint maize. The author mentions certain facts which support this claim, and discusses in detail the relative feeding values and market estimates, compared with the Argentina La Plata small flint maize.

It appears that the quantity of the fat soluble vitamine A in yellow maize is not sufficient to supply the animal, fed at normal rates, with the required amount, and an adequate substitute is necessary. According to HENRY and MORRISON (Feeds and Feeding) it has been proved, however, that yellow and white maize possess a uniform value as regards nutrition.

The white flat maize grown in Rhodesia has proved the best for the manufacture of alcohol and starch, and in the synthetic rubber industry. As regards yield, it has been noted that the old type flint variety, although excellent for the high veldts when early frosts are expected, has given only 455 bags (1 bag 200 lb.) per acre, compared with 10 to 12 bags for improved dent varieties. This should compensate for the slightly higher prices that may be offered for small flint maize on the export market.

M. L. Y.

685. Nutritive Value of the Georgia Velvet Bean (1) (*Stizolobium deeringianum*) compared with Whole and Skimmed Milk.

READ, J. W. and BARNET SURE (Department of Agricultural Chemistry, Arkansas Agricultural College) *Journal of Agricultural Research* Vol. XXIV, no 5, pp 433-440, figs. 11, bibliography. Washington. D. C., 1923.

Report of a series of investigations made by the authors to determine the supplementary relationship of whole and skimmed milk to the hulled seed and whole plant of *Stizolobium deeringianum* and of the leaf and hulls to the seed. The great abundance of vitamine A and the deficiency in salts, in quality of protein and in vitamine B has previously been shown (*Journal of Agricultural Research*, Vol. 22, pp. 5-15 "Biological Analysis of the Seed of the Georgia Velvet Bean"). Results of the present experiments indicate that the velvet-bean seed (cooked) when fed at the rate of 60 % together with 40 % dextrin; and velvet bean hay (whole plant) fed at the rate of 40 % combined with 60 % starch will supply satisfactory supplement for milk, both for growth and reproduction. The leaf is not lacking in B vitamine and contains salts of excellent biological value; the hulls on the contrary have no supplementary value and interfere with the utilisation of the A vitamine in the seed.

M. L. Y.

Breeding.

686. The Laws of Heredity and the Breeding of Farm Animals.

HUNT W. D. *New Zealand Journal of Agriculture*. Vol. XXVII, No. 2, pp. 103-111. Wellington, 1923.

The author draws attention to the importance of the stock breeder possessing marked ability in the selection of animals, as well as a knowledge of the laws of heredity.

The following is a brief record of results obtained by J. GIBSON the well-known Tasmanian breeder of Merino sheep, which are grown almost entirely for wool, the desire being to produce a sheep that would give the greatest amount of the best quality of wool. In 1868 he bred the ram Sir Thomas, the most noted Merino of his time; the heaviest fleece cut from this ram for twelve month's growth was 12 lb. The descendants of Sir Thomas, given in order, gave fleeces of the following weights respectively.—14 lb., 17 lb., 18 lb., 20 lb., 26 lb., 23 lb., 27 lb., 30 lb., 36 $\frac{3}{4}$ lb.

Thus, in a little over thirty years by selecting those variations showing increased weight of wool, the weight was increased from 12 lb. to 36 $\frac{3}{4}$ lb., and this was done entirely within the flock without bringing in any outside blood.

The discoveries of MENDEL serve to explain the reason for many results, as for example, the fact that red calves sometimes appear in pure herds of black Aberdeen-Angus cattle. Black and red are Mendelian characters,

(1) See R. 1922, No 569 (Ed)

and black is dominant and red recessive, hence the result of crossing a black animal with a red would be a black animal, although such a calf would carry in its germ-cells the factor for red. From the above it will be seen that, before a red calf can appear in black herd both sire and dam must carry the factor for red; further, that if one animal were introduced into a herd which although itself black, carried the factor for red, it would be possible in time for red animals to appear. The only way to make sure of keeping red out of a black herd is as follows:—

(a) Before introducing a new bull into a herd, test it with red or red-and-white cows. If the bull is a pure black all the calves will be black; if it carries the factor for red about half the calves will be red.

(b) Note results from bulls bred in the herd when used in cross bred herds. If any calves are red the bull carries the red factor. If the sire of this bull has been proved pure the red factor must have come from his dam, and the dam should be removed from the herd.

(c) If a red calf is born in a pure-black herd the sire and dam must both carry the red factor, and both should be removed from the herd.

Every breeder will be trying constantly to bring his flock or herd nearer to his ideal. In order to do this he can use sires of type and ancestry as near to his ideal as he can get them, or he can select with a view to correcting some weakness in his own animals — that is, if his animals have gone to an extreme in one direction he can try to correct this by using sires that go to an extreme in the other direction.

The author considers that the first method is the best, as, although the second method may produce animals of satisfactory appearance, they will not breed true.

To breed true the animals must have uniform germ-cells all carrying the same inheritance-factors. With an outcross there is always the danger of introducing germ-cells carrying the factor for some fault that may prove afterwards very difficult to eliminate, but experience has shown that animals which have been closely inbred for some time, respond quickly to an outcross.

The above consideration brings up the question whether the best plan in a large stud is not to divide the stud into several families and to closely inbreed each within itself until weakness appears; then introduce a sire from one of the other inbred families, and continue the inbreeding until another outcross is required, when another family can be used.

Another important matter when establishing a stud is that of location. Animals can be altered by environment and changes should all be in the direction of strengthening the type for the class of country in which they will live, or to which they will have to adapt themselves if sold. The location should be one where the conditions are such, that natural selection will eliminate any individual unable to thrive under the conditions of the sires bred in the stud, where they are likely to be placed when sold.

W. S. G.

[666]

687. **Cross Breeding of Swine and the Chief Results.**

LUSH, J. L. (Texas Experiment Station). *The Breeders' Gazette*, Vol. LXXXIII, No 3, p 74 Chicago, 1923

Crossbred are evidently more profitable on the market than purebreds, but it should not be concluded that these should be used for breeding. The first generation will be as good or better than the pure parents, and as uniform, but the second generation will show a slight inferiority in size and vitality. Experiments made at the Kansas Station (1914-1918) demonstrate this fact. Crosses were made between Duroc-Jersey sows and Berkshires, and the crossbred was reserved for recrossing. The average weights of the F_2 animals at birth and at each successive month are given in the following table —

Age	Crossbreds		Second generation	
	Number	Average weight	Number	Average weight
		lbs		lbs
Birth	13	2.5	130	2.4
One month	20	13.2	102	10.1
Two	20	25.7	83	18.9
Three	19	35.1	56	32.9
Four	18	47.7	55	46.3
Five	17	61.9	51	64.7
Six	1	86.0	48	87.5
Seven	15	115.6	43	113.0
Eight	13	135.6	43	130.5
Nine	13	164.3	32	137.2
Ten	13	189.3	33	159.3

It may be noted that at every period except at the 5th and 6th months, the crossbreds (F_1) averaged a heavier weight than F_2 .

More of the F_2 pigs died during the first 3 months of their life. It is considered probable, from results obtained elsewhere, that the purebreds would have been as uniform but not quite so vigorous as the first generation crossbreds. No two breeds are exactly alike as regards hereditary factors, for size, vigour, etc., and consequently when two such breeds are crossed these factors tend to predominate, and the crossbreds are inclined to be better than the average of the two parents. Each crossbred has a complete set of factors inherited from each breed, but if used for breeding, the offspring does not perpetuate these factors to the full extent. If each factor was independent it might be expected to obtain a superior quality breeds, but unfortunately in order to reproduce many of the desired characters, the combination of several factors is necessitated, and the chances of securing such results in the F_2 generation are rare. Crosses of distinct types within a breed are likely to be more successful although even this is uncertain.

Whether crossbreeding may be considered an advantage from the economic standpoint is a question for each producer, individually, and the expense of buying the breeding stock or the advantage of maintaining distinct breeds for breeding purposes only, must be considered as well as the estimation of possible increased cost of crossbreeding on the farms, compared with the diminution in value of the increase in growth of the crossbreds.

F. S.

Special.

688 Application of the Forage Equivalents Method to the Feeding of Young Foals.

LEROY, A M (Chef de Travaux à l'Institut National Agronomique)
L'Alimentation des jeunes chevaux après le sevrage. *Revue de Zootechnie*, Year 2, No 9, pp 207-217, 2 graphic charts Paris, 1923

The author here makes use of two graphic charts as when calculating the rations of young cattle (1) and of sheep (2) according to the forage equivalents method. The two graphs referring to the foals, give in the one case, the variation of the number of food units (in function of live-weight) that ought to be contained by the maintenance ration, and in the other the variations in the production (or growth) ration per given amount of live weight in function of the animal's age. As is well-known, in the case of horses, the amount of digestible nitrogenous matter in the ration of growing animals should be 1 gm. per kg. of the animals' weight, which gives the necessary data for the calculation.

The author mentions, as an instance, the rationing of heavy draught colts which generally weigh when they are about 6 months old (which is usually towards the beginning of the winter) 350-400 kg. and increase 700-900 gm daily in the course of the winter, so that when they are turned out to grass the following spring, their weight varies, according to the individual, from 450-550 kg.

A Percheron colt of 7 months weighing 380 kg. in November would need in order to gain 800 gm. a day :

a) *Ration at the beginning of the winter (November).*

Maintenance ration for colt weighing 380 kg.	3.3
Growth ration to produce increase of 0.800 kg reached at the age of	
7 months : 2.6×0.8	2.1
Total . . .	<u>5.4</u>

Therefore the ration should contain 5.4 forage units, and at the same time, supply 380 gm. protein.

(1) See R. April-June 1923, No. 231.

(2) See R. July-September 1923, No. 426.

b) *Ration at the end of the winter (March).*

Maintenance ration	3.8
Growth ration	2.7
Total	<u>6.5</u>

viz., one forage unit more than at the beginning of the winter, and about 475 gm. of protein.

In the meantime, the growth rhythm continues to become increasingly slower as the animal gets older, and at the beginning of the second winter when the colt leaves the field for the stable, the weight, if it belongs to a heavy draught breed, will be 550-650 kg. and in the following March, as the gain is about 500 gm. per day, the animal will weigh 625-775 kg. Hence the following figures are obtained:

At the beginning of the second winter.

Age: 18 months; Weight 600 kg. daily increase	0.500 gm
Maintenance ration	4.5 units
Growth ration: 4.6×0.500 kg	2.3
	<u>6.8</u>
Protein ration	6.00 gm

At the end of the second winter.

Maintenance ration	4.9 units
Growth ration	2.7
	<u>7.6</u>
Protein ration	6.75 gm

Graphic charts can also be used for calculating the rations to be fed to brood-mares during the lactation period; in this manner may be found: a) the maintenance ration of the mare; 2) the maintenance ration of the foal; 3) the growth ration of the foal. The amount of nitrogen required is calculated as 0.6 gm. of protein for every kg. of the mares weight, plus 2 gm. for every kg. of the weight of the sucking foal.

The author gives the following data (averages):

Growth rhythm in the principal types of horse.

Breed	At time of weaning		At end of first winter		At beginning of second winter		At end of second winter	
	Weight kg.	Forage units	Weight kg.	Forage units	Weight kg.	Forage units	Weight kg.	Forage units
English thoroughbred	275	4.3	350	5.3	—	—	—	—
Trotter	290	3.9	300	4.9	375	5.2	420	5.6
Draught horse poster type	275	4.6	365	5.7	450	6.4	515	7.0
Heavy draught horse	375	5.6	475	6.6	600	7.5	675	8.3

G. Tg.

689 **Duration of the Gestation Period in English Pure-Bred Mares of Racing Stock.**

BÉDEL, La durée de la gestation chez la jument de la race de course pur-sang anglais *Id Revue de Zootechnie* Year 2, No 4, pp 316-327, figs 1, tables 12 Paris, 1923

After reference to the average length of the gestation period in pure-bred Persian, Arab and Russian mares, the author gives the results of his observations on the pure-bred, English mare.

The average length of the gestation period in the case of the English mare is 348 days with a maximum 387 and a minimum of 327 days. As a rule the gestation period is 7 days longer for colts than for fillies. Its length is affected not only by causes depending on the mare and the sex of the offspring, but also by the sires procreative power which further influences the strength of the foal at birth.

On the other hand, the gestation period of some mares is habitually more protracted than that of others and is usually shortest in small animals. although considerable differences in this respect have been observed between mares of the same size. Cases have been noted where the gestation period of mares 4 to 6 years of age has been 2 days shorter than in older animals. The number of foalings does not appear to exercise any marked effect.

Some mares seem to have inherited from their dams a predisposition to carry their foals for a longer, or shorter, time. The author is of opinion that the duration of the gestation period also varies according to the weath'r

He noted that the number of colts or fillies among the foals sired by the same stallion was variable.

F. S.

690 **The Blue Cattle of North France.**

BUCHE, F., (Directeur des Services agricoles du Nord) La race bleue du Nord *Revue de Zootechnie*, Year 2, No 8, pp 133-137, figs 3 Paris, 1923

This paper contains an interesting account of the Blue breed of cattle which, although believed to be extinct by many people, and not even known to some of the chief stock-breeders of the old school, has yet re-appeared and spread in North France, in Bavay, Maubeuge and Le Quesnoy and in the Department of Avesne from Solesme to Le Cateau, the district situated between the Sambre and the Schelde that before the war was the geographic area occupied by the race. The show specially held at Cambrai on June 30 of last year, was a great revelation as to the possibilities of the blue breed. It would be as profitable as the Belgian Hainault (that has long been successfully crossed with Durhams and Dutch cattle), if the breeders of the district were to take trouble to fix anew its peculiar characters. In the meantime, the Syndicate of the Bavay breeders has decided to make a Herd-book for these blue cattle that are perfectly adapted to the slopes formed by the primary strata of the Ardennes massif which lose themselves in the plain of French Hainault.

G. Tg.

[689-690]

691 Controlling the Rations of Dairy Cows.

LEROY, A (Ingénieur agronome, Chef des travaux à l'Institut National Agronomique) L'utilité du contrôle du rationnement des vaches laitières *Revue de Zootechnie*, Year 2, No 7, pp 20-31, figs 2 and diagr. 1 Paris, 1923

Good results have been obtained in the Department of Seine-et-Oise by the simultaneous control of the milk yield and the rations of dairy cows. The control Service which was instituted and is directed by the Stocks-Breeding Committee (Comité d'élevage) of the district has been placed under the management of the Departmental Agricultural Office. The method adopted is extremely simple and consists in periodically weighing the cows and their daily ration. If this weighing is properly carried out, the work should be done in the same day as the milk is controlled, and can be done quickly and without a special Staff, as approximate accuracy is sufficient for practical purposes. Having obtained these data, the controller is able, with the help of the existing tables giving the equivalent and percentage of the nitrogenous substances present in the various foods, to calculate feeding value and protein content of the ration. Since on the other hand, he knows the average weight of cows and the average yield of milk per head, he is also in a position to calculate with the help of the ration table, the feeding value and protein content of the ration that is theoretically necessary for dairy-cows of the same weight and giving the same amount of milk. By this means it can be ascertained if the cows are being properly fed, or whether the food requirements of any animal necessitates a change in the ration.

The results obtained by this double control were then plotted on two graphic charts, three curves being drawn showing respectively, the effect of the ration on milk production, on butter yield and live-weight. An examination of these charts shows the measures to be taken in every case and especially as to how the diet should be changed.

According to the author, these three rules can be deduced from the charts.

a) If the curves of milk yield, butter production and live-weight fall abruptly and are parallel, the ration must be increased.

b) If the curves of milk yield, and butter production fall slowly, while the curve of the live-weight remains horizontal, the cows are properly fed and no change should be made in the ration.

c) If the curves of milk yield and butter production fall slowly, while the weight curve rises decidedly, the animals are receiving too much food and the ration must be slightly reduced. In the last case, the tendency to put on fat which has already showed itself, will hinder milk production. It is, however, necessary in interpreting the graphs, to take into account any abnormal falls in the curves, as these are due to acute, or chronic affections which are quite independent of the diet.

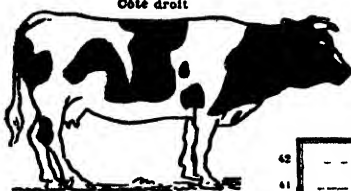
G. Tg.

Exploitation de M^r P. à N° 2

FICHE DE CONTROLE LAITIER & BEURRIER

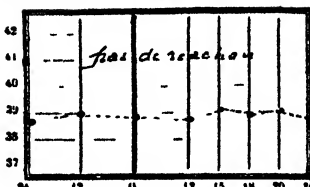
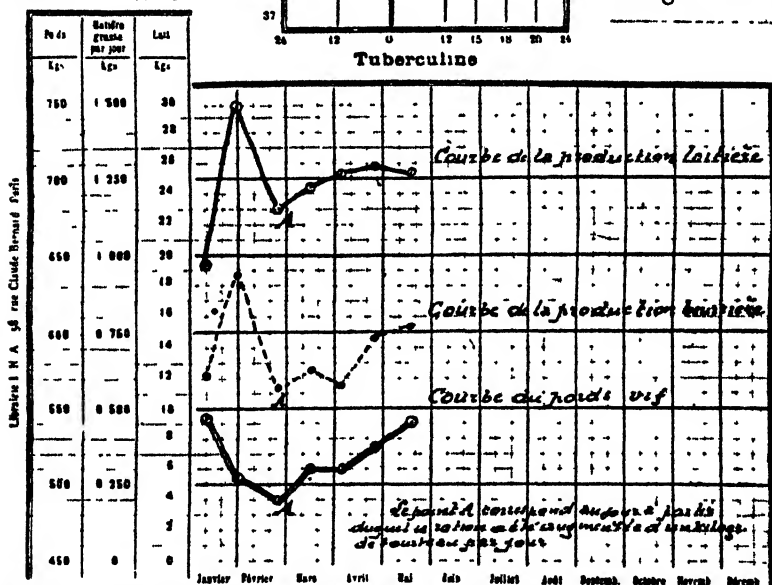
Race *Hollandaise*
Côté droit

Année 1923

N° 3
Côté gauche

Acheteé

Vendue

Herd Book
Agee de 10 ans.

Dates des saillies	Nom du taureau	Dates des vêlages	Sexe des veaux	OBSERVATIONS
2 mai 1923	<i>Nanton</i>	4 janvier 1923	mâle	<i>vendu</i>
	Date	OBSERVATIONS	Avoir	Doit
Arrivée . . .		4 janvier 1923		2.800 <i>frs</i>
Veaux . . .	15 janvier 1923		300 <i>frs</i>	
Départ . . .				
Soins . . .				
Nourriture . . .				

Différence : Nombre de litres de lait

Prix de revient du litre

FIG. 116. — Chart for Control of Rations of Dairy Cows.

692. The Optimum Quantity of Skim Milk for Calf Feeding.

WOODWARD, T E (United States Dairy Division Experiment Station, Beltsville, Maryland), *Journal of Dairy Science*, Vol VI, No 3, pp 243-244. Baltimore, 1923

Feeding experiments were conducted at Beltsville, Maryland (U. S.) with 4 groups of calves with 4 calves per group, balanced as nearly as possible with reference to breed and body weight at birth. Each calf received its mother's milk until it was 10 days old; the change to skim milk was made gradually during the following 5 days, and the feed was then an entirely skim milk ration. One group was given a daily ration at the rate of $\frac{1}{7}$ body weight, two others at the rate of $\frac{1}{6}$ and $\frac{1}{5}$ and the fourth group was given all the milk the calves would drink, twice a day. The experiment lasted 70 days. Records were kept as to gains in weight made by calves on various quantities of skim milk; at least 50 % larger gains were noted for those receiving milk *ad lib.* than for those fed at the rate of $\frac{1}{7}$ their body weight. To do this they drank about 80 % more skim milk, about $\frac{4}{5}$ more than the first group. As regards the other two groups, less satisfactory results were obtained and it has been concluded that calves which received milk *ad lib.* and at the rate of $\frac{1}{7}$ made gains more economically than groups $\frac{1}{6}$ and $\frac{1}{5}$. In addition, feeding in large quantities did not cause scouring.

G. Tg

693. Experiments in Fattening Cattle in Winter, in Rhodesia.

NOBBS E A *The Department of Agriculture, Rhodesia, Bulletin*, No 446, p 8, Salisbury, 1923

The first experiment was made with the objects of fattening two lots of cattle in one season and seeing which fattened more economically. One lot was stall-fed from the first and finished by the end of August, while the other was only put in the shed after the first lot had been sold and was not finished before November, or December.

The cattle were Shorthorns 3 $\frac{1}{2}$ years old and had been brought, in fairly good condition, from the mountains at the close of the grazing-season.

First lot: the average weight of the animals at the beginning of the experiment was 480 kg.. From May 3 to June 14, they received per day and per 1000 kg live-weight: 13 kg of ordinary hay, 4 kg. groundnut meal, 7 kg. of ground maize, 8.10 kg. "majordas"; from June 14 to July 26, the daily ration for the same unit of live-weight included 10 kg. of ordinary hay, 4 kg. of groundnut meal replaced after a week by 6 kg. of velvet-bean hay, and after 4 weeks, by 10 kg. of the same forage, 2.5 kg. dried sunflower stems, 9 kg. maize flour (increased at the end of a fortnight to 10 kg.), 2.5 kg. horse-bean flour, 1 to 2 kg. groundnut meal, 1 to 2 kg. sunflower meal, 12 to 22 kg. silage and 8 to 22 kg. "majordas". From July 26 to August 23, the ration was composed of: 6 to 8 kg. or-

dinary hay, 6-8 kg. velvet-bean hay, 6 kg. maize stalks, 10 kg., and later 9 kg., of ground maize, 2 kg. horse beans, 2 kg. sunflower meal, 2 kg. groundnut meal, 10 to 16 kg. silage and 12 to 16 kg. of "majordas" and pumpkins. The consumption per head during this period was: 640 kg. ordinary hay, 175 velvet-bean hay, 171 groundnut kg, 177 kg. maize forage, 443 ensilaged forage, 755 kg. "majordas", 521 kg. ground maize, 76 kg. horsebean flour, 67 kg. groundnut meal and 67 kg. sunflower meal

At the end of this period of 112 days the average increase in the live-weight of each of the animals in this lot was 100 kg., or 21.65 % of the initial weight.

Second lot. The average initial weight of the 20 animals was 435 kg. They were turned out to graze from May 3 to August 22, and received during this period supplementary rations to the amount of 13 500 kg. silaged forage, 13 500 kg. "majordas", 9000 kg. maize forage and 4500 kg. hay. From August 22, the cattle were stall-fed and received until September 25, per day and per 1000 kg. of live-weight: 14 kg. ordinary hay, 4 kg. velvet bean hay, 18 kg. majordas and 6 kg. maize. Between September 25 and November 6, the ration for the same unit of live-weight consisted of: 10 kg. ordinary hay, 6 to 10 kg. velvet-bean hay, 10 kg. mangels, 9 kg. at first, and later, 10 kg. ground maize, 3 to 6.5 kg. horsebean-pod flour and 2 to 3 kg. sunflower meal; from November 6 to November 27, the ration was composed of: 8 kg. ordinary hay, 10 kg. velvetbean hay, 8 kg. "majordas", 10 kg. maize flour, 6.5 kg. horsebean-pod flour, and 3 kg. of crushed sunflower seeds. At the end of this period of 96 days, the total consumption per head, amounted to: 570 kg. hay, 127 kg. velvet bean hay, 470 kg. "majordas", 178 kg. mangels, 448 kg. ground maize, 202 kg. horsebean-pod flour and 102 kg. sunflower meal.

During the grazing period, these cattle lost on an average 1.60 kg., but at the end of the experiment they had gained 9 kg. in live-weight. It is worthy of notice that at the end of the 2nd period of stall-feeding, 5 of the steers were so fat that they were sold, while the others were not much thinner, since during the last period, they only gained 0.55 kg. more aday.

Some of the animals of the same lot were fed daily throughout this experiment, a supplementary ration of 4 kg. bone-meal, but this had no apparent effect on their fattening.

The object of the second experiment was to compare the yield of Shorthorn steers and Sussex steers. The Sussex animals used were similar to those composing the second lot in the preceding experiment; they received the same amount of a ration identical with that given the Shorthorns during the stall-feeding period.

The average weight of the Sussex steers at the beginning of the experiment was 382 kg.; by the end, they had increased their live-weight 75 kg. on an average; in the case of 5 of the animals, however, the experiment was stopped at the end of the second period because they were already sufficiently fat; the 3 others, increased still more in live-weight

A record was kept of the percentage of vegetation removed annually from the various experimental pastures by grazing; an average of 51 % was noted on the continuous 100-acre pasture to 98 % on the continuous 30-acre pasture; and 76 % on the deferred pasture. To avoid injury to vegetation under a system of continuous grazing from 15-25 % should be allowed to remain on the pasture at the close of the grazing season. The most efficient system is one that will supply sufficient forage during the entire season to produce the greatest total gain in weight with a minimum number of cattle on a limited area. To ensure maximum growth and production, the deferred system has been found to fulfil the requirements to a more satisfactory extent. It should be noted that the danger of overgrazing is an essentially important point. For example both in the foregoing table and according to subsequent records of the average daily gains of steers, the 30-acre pasture bears out this statement. The vegetation evidently suffered by adopting this system

Botanical studies were made simultaneously comprising a complete survey of nearly 200 species of native plants growing on the highlands and in the prairies. Of the total number of species, approximately 50-60 % are grasses (20 % *Bouteloua gracilis*, 10 % *Stipa comata*, 30 % *Carex* spp and other vegetation). Quadrat records were kept for tracing the changes in botanical composition together with photographs and field notes. Mapped quadrats indicate the relationship between different species and a certain extent the effects of grazing thereon. The danger of overgrazing is clear as shown by the increase of *Artemisia frigida*, on the 30-acre pasture a plant disliked by cattle, and which reproduces readily and can materially reduce the grazing capacity of a pasture. A full description is given of the development of this and other *Artemisia* species and the difference in size on the respective pastures. Observations were also made as to the periods when the most important species commence spring growth and the period of seed maturity; the quantity of hay produced annually; and the effects upon total production of annual and biennial mowing; field germination tests; sowing on native soil; and soil moisture determinations.

The grasses produce from 45-55 % dry weight of all the species and indicate an area of high grazing value for cattle. As regards palatability the following species are listed in order of value: *Bouteloua gracilis*, *Andropogon furcatus*, *Stipa comata*, *Koeleria cristata*, *Bouteloua curtipendula*, *Andropogon scoparius*, *Muhlenbergia cuspidata*, *Calamovilfa longifolia*, *Stipa spartea* and *Aristida longiseta*. *Carex* spp. are attractive to stock early in the season, but as the summer advances, the plant becomes dry and tough and unpalatable. *B. gracilis* is the species least injured by heavy grazing and *S. spartea* is effected the most.

The author reviews the general results so far obtained on the different pastures and has drawn the following conclusions:

1) *Causes of deterioration of native pastures.* — Continuous grazing decreases seed production contrary to deferred grazing (after seed maturity), which system can be applied wherever plants retain their palatability after the seed has ripened and produces a seed crop, provided sufficient water facilities exist for stock.

2) *Effect on stock.* — Cattle grazing on a short range may appear to be in good condition but in reality they are only maintaining their weight. Grazing longer than 4 months has not increased the gains per head but has merely resulted in a better "finish". Under a system of continuous grazing it requires 7 acres to graze one 2-year old steer for 5 months. Deferred grazing requires only between 4-5 acres. The highest gain per head is not correlated with the highest gain per acre; on the contrary the lowest gain per head on the lowest acreage has a direct relation to the highest individual gain, provided that the cattle are not forced to remain on a short pasture for too long a period.

M. L. Y

695. **The Industrial Sheep Cross *Charmoise* × *Limousin*.**

VOITELLIER, C Recherches expérimentales sur les croisement industriel *Charmoise* × *Limousin*. *Revue de Zootechnie*, Year 2, No. 9, pp 159-174, figs 7, graphs 2. Paris, 1923.

A report of experiments carried out at the National Stock-Breeding Centre of Vaulx-de-Cerney, similar to those previously made at the same centre, upon the Southdown × *Limousin* cross undertaken to study: a) the growth of the lambs; b) the effect of castration; c) the dressing yields of hybrids of the first generation of the cross between *Charmoise* rams and *Limousin* ewes. Two lots each of ram-lambs and one ewe-lamb were used in these researches. All these animals had been born the same day, or within an interval of 24 hours. They were regularly weighed and their thoracic measurements taken every 15 days; at the end of 6 months, they were slaughtered. Since, it has been found in the case of the Southdown-*Limousin* hybrids, that the average weight of the castrated lambs at 6 months was 4-4.200 kg. less than that of the control animals, whereas their average weight at birth had been 100-200 gm. higher. The ram-lamb that was heavier at birth was castrated at the age of 15 days, in order to see more clearly the effect of the initial weight upon the later development of the animal. All three animals of each lot were fed the same rations.

On dividing the lambs into two groups, entire and castrated, and subtracting their weight at birth from their weight when sent to the butcher 6 months later, the following increases are shown:—

Entire lambs weighing up to kg. 2.190	Kg. 29.110
Entire lambs weighing over kg. 3.070	» 30.830
Castrated lambs weighing up to kg. 2.810	» 27.790
Castrated lambs weighing over kg. 3.835	» 27.865

The following more general data showing the difference between the hybrids of the two crosses were also obtained.

The unfavourable influence exerted on future development by a light weight at birth is, however, not very great except in the case of twins and then only where one is much stronger than the other. The average live weight of single lambs at the end of 6 months was 1.261 kg. more than

that of twins The difference would appear to be only 321 gm. in the case of the ewe-lambs, but was 2 kg in the entire ram-lambs.

	Weight at birth	Weight on leaving farm at end of 6 months	Increased weight in 6 months
	kg	kg	kg
Charmoise × Limousin			
Castrated lambs	3.4	31.2	27.8
Entire	2.5	32.0	29.5
Ewe lambs	3.0	27.8	24.8
Southdowns × Limousin			
Castrated lambs	3.2	33.9	30.7
Entire	3.0	28.3	25.3

			Twins					Single lambs	
			kg general	kg average				kg general	kg average
Whole	13		402.0	30.293	Whole	15	494	—	32.933
Castrated	9		265.5	29.500	Castrated	15	468	—	31.200
Ewe lambs	10		272.5	27.250	Ewe lambs	14	356	—	27.571
Totals	32		940.0	24.375	Totals	44	1348	—	30.636

Castration generally had a bad effect upon the development of the animals, but this was especially noticeable when entire and castrated lambs with the same initial weight (at birth) were compared and was still more striking when the lambs weighed the same at the time of castration, viz, when 15 days old.

In any case, the greater live-weight increase of the entire lambs at the age of 6 months did not produce a corresponding increase in the net weight of meat when the animals were slaughtered, while the percentage weight was reduced by the greater weight of their fleeces (average 600 gm) and the weight of their testicles.

Average weights and weights when slaughtered, of the Charmoise × Limousin hybrid lambs

	Weight at birth	Weight on leaving farm	Weight at time of slaughter	Net weight of meat	Dressing yield	Fat of mesentery and of epiploon	Head	Digestive tract (full)	Fleece
	kg	kg	kg	kg	%	kg.	kg	kg.	kg
No. 19 Entire	2.540	32.000	30.700	14.300	46.8	0.450	1.180	7.700	2.976
No. 19 Castrated	3.440	31.200	29.500	14.200	48.7	0.550	1.125	7.000	2.368
No. 19 Ewe lambs	3.000	27.800	27.500	13.100	47.1	0.509	1.000	6.368	2.677

G. Tg.

696. **The Beni-Ahsen Sheep.**

SCHOEFFLER (Vétérinaire Inspecteur du Service de l'élevage à Mochra-bel-Kairi). Le mouton " Beni-ahsen " *Revue de zootechnie*, Year 2, No. 8, pp. 118-120, figs 2 Paris, 1923

In Nerdja Beni Ahsen (Morocco), where the rich pastures suffer little from the summer drought, there is a breed of sheep whose origin is somewhat doubtful, although in several somatic characters the animals resemble the Spanish merinoes. The Moroccan breed, which sometimes attains the height of 0.80-85 m. at the withers (average 0.75-0.80), may be classed in the category of races of large sheep together with the Soissonais, Lauragais, Merinoes and some other types. It is chiefly a wool-producing breed. Most of the sheep are white with the exception of the head and legs which are red, or black. Sometimes individuals are found in a flock which differ from the type in certain external characters, and especially in possessing very small heads quite buried in wool. Such aberrant specimens are particularly hardy, but their wool is of poor quality; they are called *Karboub* by the natives.

The *Aboudia* type produces the finest wool, the best sheep being found in the neighbourhood of Allagua M'Kachin, Ouled Moussa, Derkaoua, Ouled Braz, Ouled Youssif and Keberta, although these sheep are kept to some extent also on both banks of the Sebou. The average gross weight of the fleece is from 1.8-2 kg. but it is not rare for an adult ram to have a fleece weighing from 4-5 kg. The wool is soft and silky, but has little resistance. The net yield is 42 to 46 %.

On going further to the north of Nerdja, the *Boldia* sheep is found, a type with a more ordinary class of wool, while near the coast, the *Remelia* type is met with; this sheep is so called because the wool is impregnated with sand (*Remel*).

On account of its conformation, the Beni-Ahsen sheep is not a butcher's animal. Its masses of muscle are not much developed, and its mutton yield is only 42 to 48 %, but uncastrated animals if kept under satisfactory conditions, may produce 53-55 % of meat.

SCHOEFFLER also describes in his monograph the various systems of breeding adopted in the region, which are usually carried out conjointly by the owners of the flocks and the native shepherds. They may be reduced to four types: 1) the *Bennoss* system (*Bennoss* means half); 2) the *Molladia* and *Bennoss* system (*Molladia* means a group with two equivalent lots); 3) system of half the births; 4) co-operative wool association.

G. Tg.

697 **Breeding Milch Goats in Holland, England and France.**

CHARON A. J. La chèvre améliorée et améliorante. *Journal d'Agriculture pratique*, Year 87, Vol. I, No 14, pp 277-280, figs. 3. Paris, 1923.

The milk yield of goats in Holland is improved either by selection from local breeds, or else by the introduction of male goats belonging to the Saanen, Toggenburg and Nubian breeds all of which are celebrated for milk production.

At the Seroskerker Station (Holland), the average milk yield of the native breeds of poor milkers is, according to ZWAGAMANN, 450 litres in 275 days, with a fat content 5 %. Hybrid Saanen \times Zealand goats give much more milk, but it is poorer in butter-fat.

In England, both the Nubian and the Swiss goat have been employed to improve the local breed. It is estimated that an ordinary goat should give 3.25 to 4.50 litres of rich milk per day, those yielding less than 2 litres per day are not considered worth keeping.

The author is of opinion that in France, the Alpine Sundgau (Alsace) breed might be used for improve the local stock, he, however, also advocates the French goats being improved by selection and suggests that the State, or some of the most important Breed Societies should interest themselves in the matter.

F. S.

698. Potatoes in Pig-Feeding.

I. — MÜLLER and RICHTER (Versuchswirtschaft für Schweinehaltung, Fütterung und Zucht, Ruhlsdorf, Kreis Teltow) Verwertung grosser Kartoffelmengen durch Schweinezucht *Zeitschrift für Schweinezucht*, Year II, Part 3, pp 39-41 Neudamm, 1923

II — *Idem*, Lassen sich in der Schweinemast hohe Kartoffeln zweckmässig verwenden? *Idem*, No 5, pp. 66-68

I. — THE USE OF LARGE RATIONS OF POTATOES IN FATTENING PIGS. — Owing to the heavy potato crop produced in Germany in 1922, and the high price of barley, the question arose as to whether it was not possible to entirely suppress the cereal ration, and yet supply fattening pigs with sufficient protein

The authors carried out some experiments in which they used 9 pigs, 5 belonging to the native improved breed, and 4 Yorkshires. The average age of the animals was 12 months. During the summer, they had been turned out to graze, but had been given a small supplementary ration of concentrates. The pigs were fattened for 6 weeks during from October 23, and received per head and per day 200 gm. of fish-meal + 200 gm. dry beer-yeast + boiled, mashed potatoes *ad lib.* The fish meal contained: crude protein 46.4 %, crude fat 3.97 % salt 9.4 %. The dry yeast contained 49.6 % crude protein, the potatoes 12.2 % starch. As the mixture was very liquid, it was necessary, in order to prevent diarrhoea, to add 200 gm. chopped oat straw per head and per day. Initial weight 95 kg. Food consumed per head per day 14 to 18 kg., average 16 kg. Digestible protein ingested 292 gm. per head, per day. The daily increase in live-weight was 799 gm. which was very satisfactory. In order to obtain 1 kg. increase in live weight, 19.72 kg. potatoes, + 0.50 kg fish-meal and beer yeast were required viz., 4.5 kg. of dry food.

It is thus quite possible and very economical to suppress all the barley-meal in the fattening ration of swine.

II. — SHOULD FATTENING SWINE BE GIVEN POTATOES? Owing to the high price of fuel, it seemed worth while trying whether pigs could not be fattened on raw potatoes. The authors carried out some experi-

ments on 36 pigs of the ordinary breed, having an initial weight of about 55 kg. and which had been fed hitherto entirely on raw food. After a preliminary week of recuperation, the animals were given for 5 weeks, beginning from February 20, the following basal ration per head and per day : 700 gm. barley-meal + 150 gm. fish-meal + 150 gm. dry beer yeast - 20 gm. washed lime. As a complementary ration, they were fed *ad lib.* : Lot 1 : steamed potatoes ; lot 2 : a mixture of $\frac{2}{3}$ boiled potatoes + $\frac{1}{3}$ raw potatoes ; lot 3 : mixture of $\frac{1}{3}$ boiled potatoes + $\frac{2}{3}$ raw potatoes ; lot 4 : raw potatoes. The pigs fed the raw potatoes showed no signs of digestive disturbances, while in the others the slightly laxative action of the cooked potatoes was evident and had to be corrected by the addition of a little chopped oat straw. Hence, the solanin in the potatoes had no injurious effect. The cooked potatoes however, were somewhat better assimilated, as was shown by the fact that the pigs receiving them increased daily in live-weight more than twice as much as the others while consuming less food per unit of live-weight, as shown by the following table.

Experiments in feeding pigs on raw and cooked potatoes.

Lot	Average initial live-weight	Average final weight	Average increase in live-weight	Potatoes consumed per head per day	Consumption per 1 kg. increase in live-weight	
	kg.	kg.	kg	kg	Basal ration	Potatoes
					kg.	kg
1	55.3	78.7	0.669	7.8	1.5	11.7
2	57.4	74.5	0.489	7.5	2.0	15.4
3	56.1	70.5	0.411	7.2	2.4	17.6
4	53.9	63.9	0.286	5.5	5.5	19.2

To heat a cauldron containing 300 kg. of potatoes, 19 kg. of coal briquettes are used and another 17 kg. are needed for boiling them. To boil the amount of potatoes consumed daily by one animal it is only necessary to use 1 kg. of briquettes which costs much less than the food saved per unit of weight.

F. D.

099. The Comparative Value as a Pig-Food of Barley, Potatoes and Various Roots.

MULLER and RICHTER (Ruhlsdorf, Kreis Teltow). Wergleichender Mastversuch zwischen Gerste, Kartoffeln und verschiedenen Rübenarten. *Zeitschrift für Schweinezeitung*, Year II, Part 6, pp. 82-84 Neudamm, 1923.

In order to ascertain whether different roots could be substituted for potatoes in fattening swine and with the further object of estimating the food value of roots and potatoes as compared with that of barley, the authors made some experiments with 45 pigs divided into 9 lots. The animals were 8 to 9 months old, their average initial weight was 75 kg. and they were fattened for 7 weeks dating from December 19.

Basal ration per head and per day : 500 gm. barley meal + 170 gm. of fish-meal + 170 gm. dry beer yeast + 20 gm. washed lime + 3 kg. potatoes containing 12-14 % starch.

Supplementary ration : *lot 1* : barley meal *ad lib.* ; *lot 2* : steamed potatoes ; *lot 3* : (5 weeks) steamed sugar-beets ; *lot 4* (3 weeks) : steamed swede-turnips, *lot 5* (5 weeks) raw sugar beets ; *lot 6* : raw carrots ; *lot 7* : raw turnips ; *lot 8* : dried slices steeped in water ; *lot 9* (3 weeks) : raw swede-turnips. All the lots, except the first and last, were fed the roots mixed with 200 gm. of chopped oat hay per head and per day.

The results are given in the following table.

In estimating the weight of supplementary rations required to produce 1 kg. increase in live weight, the 3 kg. of potatoes in the ration are taken as equal to 0.75 kg. of dry food. None of these rations gave satisfactory results, not even the one containing barley, for owing to the high price of that cereal, the daily increase in live-weight per head should have been over 1000 gm. A comparison between lots 3 and 5 shows that if sugar-beets have to be fed, they should be given boiled. None of the results obtained with the roots were good, and as cooking does not perceptibly increase their feeding value, it is best when roots must be given, to feed them raw, except in the case of swede turnips, which are not readily eaten uncooked by stock on account of the bitter flavour.

Pig-feeding trials with barley, potatoes and various roots.

Lot	Average initial weight	Average final weight	Average daily live-weight increase per head	Daily consumption of supplementary ration per head	Food consumed for production of 1 kg. increase in live-weight	
					Basal ration	Supplementary ration
	kg.	kg.	kg.	kg.	kg.	kg.
1	77.0	122.2	0.923	3.36	1.72	3.60
2	77.2	117.2	0.816	11.79	1.95	14.44
3	76.8	101.8	0.714	14.28	2.23	20.00
4	74.2	86.4	0.581	13.81	2.74	23.77
5	79.5	99.5	0.571	12.76	2.78	22.22
6	71.0	95.8	0.506	13.28	3.14	26.25
7	75.7	100.2	0.500	13.86	3.18	26.75
8	66.5	89.5	0.469	1.08	3.39	2.29
9	71.6	80.2	0.409	9.67	3.88	23.60

F. D.

700. Pig-Wash versus Mash for Fattening Swine.

MÜLLER and RICHTER (Versuchswirtschaft für Schweinehaltung-Fütterung und Zucht, Ruhlsdorf, Kreis Teltow). Ist es zweckmäßiger den Mast-schweinen des Futter in Form von Suppe zu geben oder ist die Breiform vorzu-ziehen ? *Zeitschrift für Schweinezucht*, Year II, Part 4, pp. 54-56. Neudamm, 1923.

Pig-wash to be fed hot has many disadvantages as compared with mash that does not require heating, viz.: its excessive fluidity gives

[700]

an undue amount of work to the digestive system ; it easily turns sour and therefore must be given fresh 3 or 4 times a day whereas the troughs can be refilled twice in the day ; it promotes insufficient mastication and insalivation, hence incomplete digestion ; entails greater expense for fuel and labour, etc.

The authors tested the relative value of wash and mash upon 20 young pigs about 10 months old which were being fattened. Initial weight 90 kg.; length of experiment 6 weeks beginning January 23. Supplementary ration: boiled potatoes *ad lib.*; basal ration: 1 kg. of concentrates fed as wash or mash viz. lot 1 (wash, ration poor in albuminoids) 500 gm. barley-meal + 400 gm. rye-bran + 20 gm. washed lime; lot 2 (wash, ration rich in albuminoids) 350 gm. barley-meal + 350 gm. rye bran + 150 gm. fish-meal + 150 gm. dry yeast + 20 gm. lime; lots 3 and 4 respectively, ration same as 1 and 2, but fed as mash. The results which are given in the following table show the superiority of mashes.

Pig-feeding trials with wash and mashes.

Lot	Initial weight (average)	Final weight (average)	Average daily increase in live-weight	Supplementary ration consumed per head per day	Food consumed to produce 1 kg. increase in live-weight	
					Basal ration	Supplementary ration
	kg.	kg.	kg.	kg.	kg.	kg.
1	88.6	114.8	0.624	11.3	1.6	18.1
2	94.6	122.6	0.667	11.6	1.5	17.4
3	89.4	117.0	0.657	12.1	1.5	18.4
4	95.4	127.2	0.757	12.3	1.3	16.3

F. D.

Poultry

701. **The Nutritive Substances and Energy Required by Laying Hens.**

VÖLTZ W and DIETRICH W. Untersuchungen über der Nahrstoff und Energienbedarf des Haushuhnes. *Landwirtschaftliche Jahrbucher*, Vol. LVIII, Part 3, pp. 355-377 Berlin, 1923

The experiments of the authors were made to determine the nutritive and energy requirements for egg-production and also to compare the relative value of dried beer yeast and meat meal as concentrated protein foods for fowls.

The experiments, in which 35 hens and 5 cocks of the Orpington breed were used, were divided into 4 periods, each of 28 days. During 1 and 3, beer yeast was fed, while meat-meal was given during 2 and 4. Throughout all 4 periods, the basal ration consisted of 32 % rice, 32 %

barley, 25.7 % potato flakes and 10.3 % finely-chopped clover hay. During the yeast periods, 32.1 gm. of yeast were added to every 100 gm. of the basal ration; 30.7 gm. of meat-meal being given during the other periods. The results of the analyses are set out in 35 tables. The table is reproduced that gives the relative utilisation of the energy and the digestible crude proteins present in the food. It shows that from the standpoint of egg-production, beer yeast is at least as good as meat meal when the rations contain equal quantities of digestible and available nutrient substances.

It was found that an Orpington hen of the average weight of 2.4 kg. and laying in round numbers, every other day, 1 egg weighing 58 gm. requires a total of 146 available calories per head and per day. On an average, 27 % of the available nutrient substances at the hen's disposal for egg production were found in the egg, and only 11.3 % of the available ingested nutrient substances were used in its formation. Further, on an average only 22 % of the available protein was employed in egg production. Thus, in comparison with the return of other domestic animals, that of the hen is very low (15-20 % of the available nutrient substances and 45.7 % of those at disposal for production pass into the milk of the cow, 33 % of the available nutrients go into the meat of cattle and sheep, and 15 % into that of young pigs). Under the present conditions of fowl-rearing, however, birds allowed their liberty pick up a lot of food that costs nothing and could not be used in any other manner.

TABLE I. *Utilisation of available calories of food per 1 kg. increase of live-weight in hens.*

Per kg. of live-weight and per day	Period 1 yeast	Period 2 meat meal	Period 3 yeast	Period 4 meat meal
Available calories in feed	170.7	152.3	128.5	134.4
Maintenance requirements	85.1	85.1	85.1	85.1
Calories at disposal for production	85.6	67.2	43.4	47.3
Calories in eggs laid	21.8	17.6	15.0	12.2
Idem in % of amount at disposal for egg- production	25.5	26.2	34.6	25.8
Idem in % of total available calories in food	12.8	11.6	11.7	9.2

The average weight of the eggs, their percentage of white, yolk and shell, together with their chemical composition varied little, if at all, during the different experiment periods. Sexual excitement, or its absence, that is to say the presence, or absence, of the male bird had no effect upon either the weight, or the number of the eggs produced.

TABLE II. — *Amount of crude digestible protein in the ration and its utilisation in egg-production.*

Crude digestive protein in ration	Period 1 yeast	Period 2 meat meal	Period 3 yeast	Period 4 meat meal
Per head and per day	20.3	15.9	15.1	13.5
Per kg of live-weight and per day . . .	8.5	6.6	6.4	5.8
Average weight of eggs per head and per day	33.89	27.65	23.42	20.73
Average weight of eggs per kg. of live-weight gm.	14.00	11.24	9.88	8.90
Protein in the eggs %	12.00	11.87	11.86	11.27
Weight of protein in eggs gm.	4.07	3.28	2.78	2.34
Weight of protein in the eggs produced per kg. of live-weight per day	1.68	1.33	1.17	1.00
Crude digestible protein required for maintenance per kg. of live-weight and per day	1.00	1.00	1.00	1.00
Crude digestible protein at disposal per kg. of live-weight and per day, for egg production gm.	7.5	5.6	5.4	4.8
Percentage of crude, digestible protein from the food that is found in the eggs: as compared with total protein %	19.8	20.2	18.3	17.2
As compared with productive protein . . .	22.4	23.5	21.7	20.0

F. D.

702. **Milk for Young Chicks.**

DELMAS, F. (Directeur du Centre avicole de l'Office départemental des Bouches du Rhône). Le lait en boisson aux poussins du premier âge. *La Vie agricole et rurale*, Vol. XXIII, No. 30, pp. 66-69. Paris, 1923.

With the object of ascertaining whether giving milk to young chicks would prevent the great losses that frequently occur in very young broods, especially when they belong to Mediterranean breeds, the author made experiments on 42 Leghorn chickens (of the white and brown varieties) that had been hatched on the same day. The chickens were divided into 2 lots each of 21 birds. The first lot was given milk with the addition of one-third water and weighed 987 gm., while the second had only water to drink and weighed 994 gm. Both lots were otherwise fed exactly alike. The chicks drank the milk-and-water with avidity. The experiment was continued for two months and the results obtained were indisputable: in the first lot, only 2 chicks died, whereas the number of deaths in the second lot was 6.

These results were confirmed by experiments conducted on vitamins, for if vitamine A (antirachitis) is deficient in the food ration of chicks, it should be introduced into the average ration, even if the ration contains sufficient vitamine B (antineuritic) from the liberal grain supply, and also plenty of vitamine C (antiscorbutic), which can be obtained from green food.

G. Tg.

703. Experiment to Determine the Feed Value of Dry and Moist Paste for Egg Production.

OWEN, JOHN, A (Lecturer in Poultry Culture, Grootfontein School of Agriculture). Poultry Feeding, Interim Report on an Experiment. *Journal of the Department of Agriculture*, Vol VI, No 2, pp 176-177 Pretoria, 1923.

The experiment, which lasted from August 8, 1921 to August 7, 1922, was carried out on two uniform lots of South African Utility White Leghorns aged from 9 to 10 months.

Paste given to both groups: equal parts by weight of wheat and sharps + 20 % meat-meal + a little finely powdered wood charcoal + 0.5 % salt. In the case of the group fed moist paste, sufficient water was added to the mixture to make it crumbly and it was then given at the rate of 60 gm. per head, when intended for the group fed dry paste, the mixture was poured into an automatic hopper for the fowls to eat at will. Grain ration for both groups: 2 parts by weight of oats to 1 part by weight of crushed, yellow maize, given in the afternoon at the rate of 60 gm. per head. Green stuff, consisting of lucerne, or cabbage-leaves, was fed *ad libitum* at midday.

The egg-production obtained with the moist and the dry paste respectively were: August 1921: 249, 245; September 1921: 349, 314; October 1921: 353, 315; November 1921: 313, 314; December 1921: 290, 293; January 1922: 200, 237; February 1922: 134, 211; March 1922: 70, 170; April 1922: 44, 104; May 1922: 11, 52; June 1922: 35, 71; July 1922: 51, 201; the last 4 being winter months. The total production of the first group was 2099 eggs and of the second 2529 eggs. The second group laid eggs of greater average weight.

The dry feed needs less labour in distribution and carries the birds better over the moulting process, which in the case of the second group, lasted a shorter time. During the hot months, the eggs of the second lot remained large, whereas those of the first lot decreased rapidly in size. It was also found that the fowls fed on dry food consumed 60 gm. more on an average than those given moist paste. In June 1922, a cock was allowed to run with each lot and it was noticed that the eggs of the hens fed on the dry mixture hatched out sooner than those of the others.

The experiment was repeated for 12 more months, but the group which in the first test were given dry rations, now received moist food and *vice versa*.

F. S.

704. Effect on Egg Production of Artificial Lighting of Poultry Houses in Winter. (1)

DENIS, G Nouvelle relation sur l'éclairage artificiel des pondeuses en hiver. *La Revue Avicole*, Year 33, No. 3, pp. 195-197. Paris, 1923.

During the winter 1921-1922, the author used to shut up his hens in the fowl-house as soon as it became dark, but he turned on the light from

(1) See R. 1919, No. 231. (Ed)

9.30 p. m. to 10 p. m. and supplied the birds with food and water. As the arrangement gave good results, he repeated the experiment during the following winter with one important modification. The fowls were shut up when it became dark, but the hen-house was lighted from the time of their return until 10 p. m. Very small grain, barley and oats, and especially millet, were scattered on the ground amongst the straw and sawdust, and at 9 p. m., the birds were given a grain different from that fed them during the day. The fowls had a liberal and varied diet: black oats, buckwheat, barley and oats, millet and a mixture (maize, hemp-seed and sunflower seeds), as well as paste every day early in the morning, and household scraps with the addition if a little fish meal or meat meal and powdered oyster-shells at 11 o' clock. Ten days after this régime was started, the birds' combs became of a brighter red and they regained their lively gait. By November 1, a large number of the hens were already laying; on the 15th almost all were producing eggs, and on the 20th, out of the 115 fowls belonging to the various breeds which included White and Buff Wyandotte, White and Buff Leghorn, Black La Bresse and Bourbonnais, there was not a single hen that was not laying.

The author estimates that without the use of artificial light, only 20 to 25 of the hens would have been laying and their egg production would have been much more irregular. The increased egg supply obtained would thus appear to be due to the influence of the light, which by shortening the hours of darkness not only allowed the fowls to lay until 10 o' clock at night but also made it possible for them to take in the store of food needed for the production of a large number of eggs. F. S.

705. Observations on the Number and Weight of Hens' Eggs.

LIENHART R. Observations sur le nombre et le poids des œufs de poule, *Comptes rendus des Séances de la Société de Biologie*, Vol. LXXXVIII, No. 14. pp. 1103-1106, fig 1. Paris, 1923.

The author's remarks refer to fowls kept in enclosed runs and fed a ration of constant nutritive value. The facts noted were the same in the case of the Black Bresse, Leghorn, Minorca, Houdan and Faverolle breeds respectively.

Ten La Bresse hens laid altogether 1150 eggs during their first year, 800 in the second; 570 in the third; 265 in the fourth and 83 in the sixth. The average weight of the eggs was 45 gm. the first year; 59 the second and 60 the succeeding years. Hence: 1) under normal conditions of feeding, hens produce most eggs the first year of laying; 2) two-year-old fowls that lay larger eggs, need more intensive feeding, 3) the number of eggs laid the first year can only be increased by liberal and systematic feeding; two-year-old hens must be chosen for sitting, since they have the greatest vitality; 5) in order to carry out the selection of sexes by means of the author's method (1), it is necessary to take eggs laid

(1) See R. 1919, No. 959. (Ed.)

by hens of the same breed and also of the same age, because the average weight of the egg produced by a hen of the same breed varies according to the age of the bird.

F. D.

706. Duck Rearing in Rice-Fields.

SAMPIETRO G. *Il Giornale di Riscoltura*, vol XIII, No 6, pp 91-93 Vercelli, 1921.

The association of carp-breeding and rice-cultivation appears to have been very successful in Italy (1), hence rice-growers, at the suggestion of the author, have begun rearing ducks on a large scale in the rice-fields

According to one of the duck-breeders, CERATI, of Vercelli, it is possible to keep about a hundred ducks on a hectare without any injury to the crop. If the birds weigh on an average 1.5 kg in August, and are then sold at 6 lire per kg, they bring in a gross return of 900 lire per hectare, as against a total expenditure of 300 lire per hectare. The gain is certain, for, so far, no epizootic diseases have appeared in rice-fields where ducks are reared.

The best variety to keep is the common domestic duck, for the Normandy breed, which is much larger, should only be introduced when duck-breeding on a large scale is practised. It is not advisable to cross the common duck with the larger Moschat species as the hybrids are sterile.

Duck-breeding is best started by buying a setting of eggs and hatching them in an incubator, the ducklings should be fed for some days on middlings, to which a little barley meal may be added, they ought then be turned out to feed in the rice-fields from the beginning of June, when the plants have developed good roots and are growing strongly, until towards the middle of August, before the rice-grain hardens. In this way, the young birds find all the food they require, and are useful to the rice crop, since they eat the seeds and destroy the seedlings of the weeds. In order to prevent the young ducks from feeding irregularly and straying, they should be enclosed in a movable wire-netting fence about 50 cm. in height which can be transported from one part of the field to another as the food becomes exhausted.

In rice-fields where carp are bred, ducks can only be kept with young fish in their second summer, for they destroy the fry.

In the middle of August, the ducks can either be sold for fattening, or fattened for some time on the farm where rice and maize waste, bran, spoilt potatoes, well-crushed beets, etc., can be used for the purpose.

F. D.

(1) See R 1922, No. 1354 (Ed.)

*Bee-Keeping.***707. The Production of Bees and the Age of their Queen.**

BRUNNICH, F. (Bezirkslehrer, Kaiserstuhl). Die Leistungen der Bienenvölker in Bezug auf das Alter der Königinnen. *Schweizerische Bienen-Zeitung*, Year XLVI, No. 5, pp. 228-231. Aaren, 1923.

It has been stated that queen-bees are only in full vigour during the first year of their life and that in order to have efficient hives of bees they must have a new queen annually.

Prof. BRUNNICH, the father of the author, has tested the truth of this statement experimentally by determining every year from 1908 to 1921, the amount of honey (supply left in the hive + amount taken), made by 111 hives of bees with a queen one year of age; 61 with a two-year-old queen; 41 with a three-year-old queen and 10 with a four-year-old queen. The results thus obtained (published in the *Archiv für Bienenkunde*, Part 4, 1922) show that a queen two-years of age proved the best almost every year.

Since the season is the chief factor determining the amount of honey produced, the general averages for many years are much less significant than the average for the same year of all the hives with queens of the same age. A few of these data are given below:

	1908	1910	1916	1920
Queens 1 year old kg. of honey	26.8	16.5	11.2	19.0
" 2 years " " " "	29.7	21.1	16.0	16.3
" 3 " " " " " " " " "	29.4	16.1	15.6	12.3
" 4 " " " " " " " " "	23.5	24.7	14.9	14.4

The author has continued these observations adopting the following notation: 1 = the production of 2.55 kg. of honey, 2 = 5.51 kg. and so on, up to 10 = 25.5 kg. The observations were repeated in successive years with the same queens, in order to eliminate individual variation and the results confirm those obtained by his father. In the three year period 1917-1919, the hives with queens respectively 1-2-3-4 years old had the average points 8.70-9.07-8.07-6.29, while in the 1904-1919 period, these averages were respectively 8.32-8.54-7.69-6.36.

The author also found that a good queen showed her superiority from the first year, and the one producing the best swarms the first season, continued to be superior to the other queens of the same age in all the successive years.

F. D.

708 Reinforced-Concrete Beehives.

Journal of the Department of Agriculture, Vol. VI, No. 1, pp. 23-34. figs 2, Pretoria, 1923.

Beehives of reinforced-concrete have been made at Potschefstroom South Africa. The only one that has so far been used has given satis-

factory results, and it is proposed that experiments be made with this new type of hive in the course of the summer and during the following winter. The author gives the temperatures of a concrete and wooden hive respectively when exposed to the full sun.

Temperatures of the two hives (in degrees Fahrenheit).

Reinforced concrete hive	Wooden hive	Dates	Time of day
98° F	103° F	September 18, 1922	Midday
98° ₅	104°	September 20, 1922	Midday
49°	51° ₅	September 21, 1922	6 a. m.
50°	53°	October 1, 1922	6 a. m.

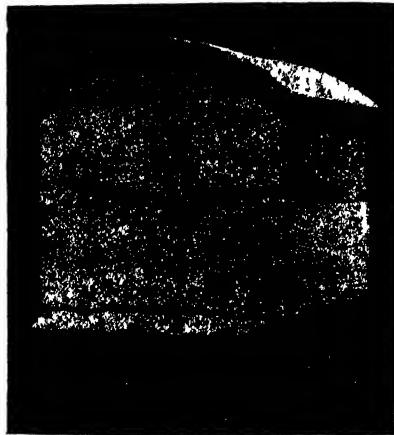


FIG 117 — Reinforced Concrete Beehive

These hives were empty, but other experiments will be made with hives containing bees. F S.

Sericulture.

709 The Development of Silkworms.

NICASTRO, C (R Istituto Bacologico, R Scuola Superiore di Agricoltura, Portici) (Intorno allo sviluppo del baco da seta) *Il Coltivatore*, Year 69, No. 26, pp. 237-242 Casale Monferrato, 1923

This paper is a contribution to the study of the larval development of the silkworm. The author extended his investigations (daily weighing), to 10 varieties. The following data are the averages obtained for the four native, yellow varieties, "Fossombrone", "Giallo abruzzo", "Brianza"

and "Sferico". By differences in growth, or "relative growth", is understood the difference between the weight attained and the initial weight; "quotient of growth" signifies the relation between the weight gained and the initial weight, while the relation between the weight gained and the weight at hatching is expressed by "absolute, weight"; "rate of growth" means the relation between relative growth and the duration of active life. The "index of absolute growth" and the "index of relative growth" signify respectively the value of the various quotients at different ages taking the value of the quotient of the first stage as 1

The development of the silkworm
(Average for 4 yellow native varieties).

	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
Difference in growth	0.007089	0.03627	0.16752	0.69019	2.4539
Growth quotient	13.584	6.058	5.510	5.698	4.184
Absolute growth	13.584	75.145	383.021	1641.181	6058.050
Rate of growth	2.070	1.223	1.144	0.993	0.713
Index of absolute growth	1	5.527	28.161	121.114	425.271
Index of relative growth	1	0.445	0.405	0.372	0.301
Index of rate of growth	1	0.599	0.562	0.494	0.365

The figures given in the above table show the following facts. As the silkworms grow older, it is seen that . 1) The absolute weight, and still more the index of absolute weight, increase; 2) the quotient of growth viz., the capacity of weighing multiplication decreases; 3) the rate of growth decreases progressively, but not regularly. According to Dr. CARLO JUCCI (*Sulla curva di sviluppo del baco da seta*, Portici, 1922), this decrease is due to the self-poisoning of the organism caused by an accumulation of catabolic products. The moult rejuvenates the digestive system and purges the excretory system, thus rendering the insect capable of renewed energy of anabolism. This rejuvenescence is, however, merely relative, the real period of youth being after the first moult. Hence the importance of giving every care to silkworms during their first days of life and the crisis of the first moult; they should pass through their early stages on the Friulian trestle (1). F. D.

710. Silk-Worm Breeding in Cambodia.

FABRE, A. (Silk-worm-Breeder and "Seed"-Bearer at the Sericultural Station of Petit Takeo, Cambodia), *La sériculture au Cambodge*, in *Bulletin Économique de l'Indo-Chine*, Year XXVI, No. 158, pp. 65-77. Hanoi, 1923.

Cambodia would appear to be an ideal country for rearing polyvoltine breeds of silkworms, for the broods hatch out there regularly, and in spite of the generations succeeding one another every 42 days, the hardiness of the insects is in no wise impaired. The mulberry-trees bear a fresh

(1) See R. 1918, No. 327. (Ed.)

crop of leaves every two months, so that there are always young juicy leaves for the new broods of caterpillars

There is, however, one obstacle to the silkbreeding industry in Cambodia, and that is the shortage of labour, for with an area of 173 000 square kilometres, the population is only 2 402 000, or 14 persons to the square kilometre, which is very little for an essentially agricultural country.

The author is, however, of opinion that this difficulty could be overcome to a considerable extent, by rearing the silkworms on the branches. By this means the cocoon production of Cambodia that is now said to be 3 million kg. could, he believes, be increased to 10 to 12 million kg. In the present centres where silkworm rearing is carried on all the year, the production would be doubled and the output could be considerably increased in the other districts where silkworms are only kept to supply the domestic silk industry.

The author studies successively the following questions. The mulberry tree — polyvoltine breeds of silkworms — the egg — the silkworm — rearing the silkworms on branches. This consists in placing the larvae, after the 4th moult, upon branches bearing leaves, detached leaves being only fed to the worms during their 4 first stages. It is estimated that a rearing which consumes 1000 kg. of leaves throughout its larval life requires about 250 kg. during the 14 days making up the four first stages, while the remaining 750 kg. are devoured during the 6 days of the 5th stage. The present method of feeding of this brood requires 39 days of woman's work, whereas if the branch method is practised, one woman would be able to tend the insects during the 20 days of larval life (a gain of 19 days) the cocoon, the moth, and the diseases and enemies of the silkworm. The author has found no signs of pebrine, or of flacherie, and only registered one epizootic case of grasserie; he studies the "rù" fly, a near relative of the "con nhang" fly of Tonkin, and describes the means of controlling this parasite.

The author concludes his paper by mentioning certain measures he considers likely to promote the development of silkworm breeding in Cambodia and throughout the whole of Indo-China, and studies the environment best suited for the breeding of polyvoltine silkworms, and the effect of environment on development of inherited characters, that is, of local types, giving each of the special features associated with the thread. A silkworm-egg producing establishment would create a bond between the different seed establishments of the Indo-Chinese Union, and small model silkworm nurseries would serve for small rearings which could be supervised by an expert European breeder. (Correspondant Indo-China).

BIBLIOGRAPHICAL NOTES.

711. MATTE E. Mammitis de las vacas lecheras. *Boletín de la sociedad nacional de Agricultura*, Vol. LIV, No. 2, pp. 92-98 (Mammitis in Dairy Cows). Santiago, Chile, 1923.

This article is based on the work of the "Instituto biológico de la Sociedad nacional de Agricultura" of Chile. It describes the symptoms and

course of mammitis in dairy cows, states the micro-organisms that may induce the disease (*Bacillus pyogenes*, *Staphylococcus pyogenes*, *Streptococcus pyogenes*, etc.), warns stock-breeders of the means by which the infection is spread, and gives the hygienic measures for its prevention, describing the method of prophylactic vaccination and the treatment of the disease.

J. P. C.

712. WEDEMANN. Über die Keimschädigende Wirkung von Torfstreu (On the Antiseptic Value of Peat Litter). *Zeitschrift für Infektionskrankheiten parasitäre Krankheiten und Hygiene des Haustiere*. Vol. XXV, Pt. I, pp. 64-73. bibliography. Berlin, 1923.

Report of laboratory experiments made to test the antiseptic action of peat. The tests prove that such action is characteristic and is especially marked for micro-organisms contained in liquids the quantity of which is not in excess of the absorptive capacity of the peat. Peat litter reduces the virulence of pathogenic microbes and hence is to be recommended in the case of epidemics.

F. D.

713. SIMONNET, H. Quelques faits nouveaux concernant les matières minérales. (New facts relative to mineral compounds). — *Revue de Zootechnie*, Year 2, No. 8, pp. 142-146. Paris, 1923.

New facts relative to the transformation and assimilation of mineral compounds, especially those phosphatic and calcium compounds having an effect on: 1) a substances of a chemical nature allied to the fats; 2) the value in diet of the phosphorus calcium ratio; 3) the amount of light received by animal organisms.

G. Tg.

714. BRODY, S., RAGSDALE, A. C., TURNER, C. W. The Rate of Growth of Dairy Cows. — *The Journal of General Physiology*, Vol. V, No. 4, pp. 445-449, tables 2, fig. 1. Baltimore, 1923.

On the basis of the weights of 14 600 Jersey cows aged from 2 to 17 years, the authors state that from the age of 2 to 17, the growth diminution curve is almost the same, while a similar uniformity marks the curve representing monomolecular chemical reaction and the percentage of the decrease in the growth rate while the increase in age remains constant.

F. S.

715. HALNAN, E. T (School of Agriculture, Cambridge) *Animal Nutrition*, 2/- Benn Brothers Ltd. London.

A concise account of the science and practice of the feeding of farm animals

W. S. G.

716. CLARK, J. (Superintendent, Experimental Station, Charlottetown, P. E. I.) and TINNEY, B. F. (Assistant), Steer Feeding Experiments in Prince Edward Island, 1912-1922 *Department of Agriculture Dominion of Canada, Pamphlet No. 23, New Series.* Ottawa, 1923.

The authors give a brief account of the best method of dehorning steers for fattening, and discuss the advantages of raising hornless cattle. They also compare the respective value for winter-fattening of : 1) beef and milk types ; 2) steers and dry cows , 3) good quality and inferior quality steers. They then consider feeding methods and the use of sheds. Winter fattening of steers is very profitable on mixed farms. Dehorned animals fatten and sell better than others. Little profit is likely to be obtained from fattening dry cows during the winter ; building sheds is an unnecessary expense ; it is more profitable to sell the food produced on the farm in the form of beef than in that of forage, or other food stuffs F. S.

- 717 BLIAS, F. M. Le postier breton (Breton Horses) — *Revue de Zootechnie*, Year 2, No 8, pp 105-112, figs 3 Paris, 1923

A short monograph describing this type of horse which is very common in the North and South of the Department of Finistère and is derived from a cross made (1844) between the native draught-mare (a thick-set, medium sized, nervous animal) and an English stallion of the Norfolk breed. The characters of the Breton breed are now well fixed. These horses are suitable for heavy and light draught work, and as a result of the richer soil of the Leon district (North Finistère), the frame-work of the horses in that region is better developed than in the case of the animals bred at Cornouaille (South Finistère). G. Tg.

- 718 GAZZONI, G. La ferratura considerata come fattore della velocità nel cavallo (Shoeing and its Effect on Speed of Horse) — *Il Moderno zootauro*, Year XXIV, No 8, pp 199-202, figs 3 Bologna, 1923

A short paper written to show that the shoes fixed to the feet of a horse contribute directly to increasing the length of its stride. This is due to the thickness of the shoe, the presence of nails, and still more to the lengthening of the heel.

The author's view are supported by three carefully plotted graphic charts. G. Tg.

- 719 GOUEN, R. (Ing. Agrom.) La race bovine mancelle (The Mancel Breed of Cattle) — *Revue de Zootechnie, La Revue des Eleveurs*, Year 2, No. 5, pp 353-361, figs 4 Paris, 1923

The origin, description and habitat (Maine and Anjou) of this breed, which tends to disappear and the reasons for its survival hitherto. As long ago as 1850, when Durhams were imported, and horses began to take the place of oxen in teams, the Durham-Mancel cross was preferred to the pure-bred Mancel, as the latter animal does not mature sufficiently early for the butcher and is a poor milker ; it is to-day replaced by cattle of the Mancel-Anjou, or the Norman breed. F. S.

720. CODINA J. Los bovinos españoles. (Spanish Cattle Breeds). — *El progreso agrícola y pecuario*, Yea XXIX, No. 1286, pp. 165-174, figs 7. Madrid, 1923.

On the occasion of the last Cattle Show at Madrid ("Concurso nacional de ganados"), the author wrote this article describing the various Spanish breeds exhibited which included the Gallegan, Asturian, Pyrenean, Tudelán, Leonese, Zamoran, Sevillian, Serranan, Estremaduran, Andalusian and Murcian.

J. P. C.

721. HAMILTON, T. Hand Rearing of Calves. *The Rhodesia Agricultural Journal*, Vol. XX, No. 5, pp. 555-564 plates 4. Salisbury, 1923.

Description of the advised treatment of calves at birth; rations including use of milk scale, supplementary feeds e. g. porridge, solid feeds, concentrates, and whey; a well equipped calf shed; "scour" disease and prevention methods; dehorning.

M. L. Y.

722. SCIPIONI, S. Razze ovine italiane (Italian Sheep Breeds) With Preface by DE ANGELIS D'OSSAT on The Ancestry of Sheep, figs. 6, tables 15. Catania, 1923.

The author has collected information concerning the Italian sheep breeds, as a guide to zoologists and stock breeders, and also regarded from the economical standpoint. The description is given according to the district in which raised. When possible, reference is made to ethnological classification taking count of the principal types and origin. This grouping has, however, only a relative value as too much uncertainty yet exists as to the physical characteristics of the breeds. In the Preface Prof. de Angelis d'Ossat compares the present existing types with the ancient types (subfossil and fossil).

723. A. S., Elevage du mouton en Nouvelle-Calédonie. *Revue agricole, Organe officiel de la Chambre d'Agriculture et du Syndicat agricole de la Nouvelle-Calédonie*, No. 91, pp. 3-5. Nouméa, 1923.

Review of the development of sheep raising in New Caledonia with a discussion as to future possibilities. The prevailing climatic conditions (long rainy periods) are contrary to the effective rearing of sheep on a large scale. Hence the repeated checks which have arisen since colonisation was started. The sheep serve chiefly for meat purposes, the wool is sometimes sent to Sydney, but is of low sale value compared with Australian wool.

F. D.

724. ASHTON J. A History of Hogs and Pork Production in Missouri. *Monthly Bulletin of the Missouri State Board of Agriculture*, vol. XX, No. 1, pp. 75, figs. 11. Jefferson City, Missouri, 1923.

A brief account of historical facts and conclusions connected with pig-breeding in Missouri. The sources drawn upon by the author are trust-

worthy, and some of the data are here published for the first time. The period covered dates from the first introduction of swine into the State by Hernando DE SOTO in 1541, up to the end of 1922. Much other information respecting the agricultural and rural history of Missouri, and numerous historical data bearing more or less upon the subject under discussion are also given.

F. D.

725. VIELHAUTER Die Zucht des Weissen Edelschweins in Deutschland
Zeitschrift für Schweinezeitung, Year II No 5, pp 69-92 Neudamm, 1923.

A discussion as to the advisability of breeding Yorkshire pigs in Germany, with a view to improving the local breed, and of the necessity of forming a Union of the German breeders of the Yorkshire which is a pig now kept more or less widely in the country and capable, in the author's opinion, of being maintained true to type without any introduction of fresh blood. The author regards Yorkshire pigs as exceedingly useful for the production of pure-bred stock, or of commercial hybrids

F. D.

- 726 CUGNINI, A Ricerche sulla secrezione latte della scrofa in rapporto all'allattamento artificiale dei maialini *L'industria lattiera e zootecnica*, Year XXI, No 4, pp 45-46 Reggio Emilia, 1923.

This article gives the average amount of milk secreted by the sow and taken by the piglings in 24 hours. As the composition of sow's milk is known, these figures can serve as a guide for the artificial feeding of sucking-pigs and for selecting the foods to be fed at the time of weaning.

G. Tg

727. *La Revue Avicole*, Standard du Lapin "Lièvre Belge". (Standard of the Belgian Hare) Year 33, No 6, pp 205-206 Paris, 1923

The standard for this animal has been taken from "The National Belgian Hare Club" and adopted by the Commission des Standards de la Société Française de Cuniculture of May 12, 1923. The general characters and scale of points are given.

G. Tg

- 728 *La Revue Avicole*, Standard de la race Wyandotte. Year XXXIII, No 4, pp 135-138, figs 2 Paris, 1923

This article gives an account of the general characters and disqualifications of the Wyandotte cock and hen. The different varieties of the breed are also enumerated with the scale of points for each, the varieties being as follows: white, buff, blue, buff-laced, blue-laced, silver, gold, silver-pencilled, gold-pencilled, partridge, cuckoo, black and black laced and columbian.

F. S.

729. *La Revue Avicole*, Standard du Canard "Rouen clair", Year 33, No. 8, pp 264-266, figs 2 Paris, 1923

Schedule for the "Rouen clair" duck adopted by the "Commission des Standards" May 29, 1923 and including the breed characters, defects and scale of points.

G. Tg.

730. BROWN E. *Poultry Keeping in the Farm*. Price 2/- (Successful Farming Series), Benn Brothers Ltd. London.

A pocket-manual on Poultry Keeping by the President of the International Association of Poultry Instructors and Investigators.

W. S. G.

731. SHEPPHARD, W. J. (Provincial Apiarist), FINLAY, A. W., and ROBERTS, J. F. Bee Culture in British Columbia. *Province of British Columbia, Department of Agriculture Bulletin* No. 92, 60 pp., 48 illustrations. Victoria, B. C., 1923.

A short, but complete, treatise intended to serve as a guide to bee-keepers of British Columbia. Modern apicultural technique is carefully described and all the commercial questions connected with the bee-keeping industry are also dealt with. The Ministry of Agriculture has organised modern apiaries (which have given good results), with the objects of insuring the development of the industry and spreading technical instruction in bee-culture. The authors give a complete review of the honey-bearing plants of the province; one of the most important of which is *Epilobium angustifolium* known as the "Indian pink" and "rose bay", as well as by its more common name of 'fire-weed'. Sufficient hints are given respecting the two forms of foul-brood, the American Ropy Foulbrood and the European Melting Foulbrood caused respectively by *Bacillus larvae* (sporogenous), and *Bacillus phuton* (asporogenous). The authors mention the regulations adopted by the United States and Canada for preventing the importation from Europe of bees affected with Isle of Wight disease, caused by *Tarsonemus Woodi* which lives in the respiratory organs of the adult insects.

G. Tg.

732. DRIEBERG, C. (Secretary Bee-Keepers' Association, Ceylon, and a Vice-President of the Apis Club). Bee Keeping for Beginners. *Department of Agriculture, Ceylon, Bulletin* No. 63, 20 pp., tables 4, illustrated. Colombo, 1923.

The author gives the rudiments of bee-keeping in a concise, but clear, manner. He includes a description of the life-history of *Apis indica* (*Memessa* S.), the large bee of the East which makes very large combs; this is the common honey-bee of the East of the island, and the only domesticated species. Some remarks are also made regarding *Apis dorsata*. Other species described are: *Apis florea* (*Danduwelmessa* S.) a smaller insect than *A. indica*, and *Melipona iridipennis* (Kaneya S.). The local names of the plants visited by the bees are also given in some cases: Mi (*Bassia longifolia*), Reteriya (*Murraya esotica*), Padouk (*Pterocarpus indicus*), Kon (*Schleichera trijuga*), Divi-divi (*Caesalpinia coriaria*), Bulu (*Terminalia belerica*), Dhall (*Canarium indicus*), Jambu (*Eugenia*).

G. Tg.

FARM ENGINEERING.

SYNTHETIC ARTICLE.

733 **Gas Generators, and Vehicles carrying Gas-Generators and Running on Naphthaline.**

I. — DANTIN, CH. Les camions à gaz pauvre. *Le Génie civil*, Vol LXXXII, No. 5, pp 100-103, figs. 11; No. 6, pp. 130-133, figs. 11. Paris, 1923.

II — COUPAN, G. (Commissaire général du Salon de la Machine agricole). Les machines agricoles au début de 1923. *Ibidem*, No. 9, pp. 199-203. 1923.

III — FICHET, A. Utilisation du bois dans les gazogènes. *Ibidem*, No. 12, pp 277-280. 1923.

IV. — PETTRÉ, F. Les gazogènes au Deuxième Salon de la Machine agricole. *Journal d'Agriculture pratique* Year 87, No. 9, pp. 176-177. Paris, 1923

V — PASSELÈGUE, G (Chef de Travaux à la Station d'Essais de Machines à Paris). Essais de tracteurs à gaz pauvres. *Ibidem*, No. 39, pp. 260-261. 1923.

I. LOW-GRADE-GAS LORRIES. — After explaining the working of gas-generators and their adaptation to travelling on the road, M. DANTIN gives a report of the Competition of the Automobile Club de France which began at the end of June 1922 and lasted about a month. The 6 following vehicles which were entered by 5 makers took part in the competition.

1 Lorry of the Société du Gazogène Lion.

1 Lorry of the Société du Gaz Pauvre and the ways in which it can be used (G. A. P.).

2 Lorries of the Société française de Matériel agricole et industriel à Vierzon.

1 Lorry of the Thornycroft Society.

1 Lorry of the Société des Gazogènes Cazes.

Their characters are summarised in Table I.

TABLE I. — *Characters of competing vehicles.*

Type of Gas Generator	Make of chassis	Engine	Weight unloaded but ready for the road
Lion	Saurer	4 cyl. 110 × 140	3820 kg.
G P. A.	Saures	4 cyl. 110 × 140	4093 "
Cazes	Brazier	4 cyl 110 × 140	4422 "
Vierzon No. 1	Delangère	4 cyl. 110 × 140	3610 "
Vierzon No. 2	Scemia	4 cyl. 125 × 140	4695 "
Thornycroft	Thornycroft	4 cyl. 114 × 152	4250 "

The author gives a detailed description of each type of gas-generator. The competing machines were subjected to two series of trials: 1) bench tests in the laboratory of Automobile-Club de France; 2) two road tests at 15 km. per hour on a closed course of 62 km.

Several observations may be made after examining Table II.

TABLE II. — *Bench experiments.*

Classification	Group	No. of marks	Average pressure when fully loaded in H. P.	Average power when fully loaded in H. P.	Consumption of type combustible per H. P.	Calories consumed per H. P.
1	Vierson No 2	955	2.66	20.60	634	4565
2	Vierson No 1	743	2.40	15.50	612	4406
3	Thornycroft	671	3.00	24.30	794	5717
4	Lion	630	2.60	16 05	884	6265
5	G. P. A.	465	2 54	15.80	779	7609
6*	Cazes	410	2.41	20.40	657	4687

* The proper working of the Cazes lorry was prevented by accidents

In the first place, the average pressure when the vehicle is fully loaded is perceptibly less than in the case of a lorry running on petrol which, when the engine is not forced, ranges from 4.5 kg. to 5.5 kg. per cc. This causes a loss of power that may reach 50 % as compared with the power developed when the vehicle runs on petrol. The transporting capacity is not, however, reduced in the same proportion because the lorry hardly ever exerts its full power on the road. Experience has shown that the transporting capacity of the lorry is not reduced to any noticeable extent. Further, by the use of special engines of much higher volumetric compression, it would be possible to obtain greater pressure. The thermodynamic return, which is only a function of the degree of compression, would in this way be considerably increased.

At the conclusion of the bench experiments, the engines were dismantled and examined. This investigation revealed carbon deposits on the pistons and cylinders of a similar character to those found in the case of petrol engines, but much thicker; traces of tar were also found. These deposits were not sufficient to interfere immediately with the working of the engines, they only point to imperfect cleaning and show that the machines must be carefully looked after.

In the *road trials*, the six competing lorries covered the course in two consecutive days, each running 124 km. without cleaning. The results are given in Table III.

The general classification of the competing lorries was made by taking into account the marks obtained both in the bench and the road trials. The vehicles were classed as follows: 1 Thornycroft, 2, Vierson No. 1, 3 Lion, 4 Vierson No. 2, 5 Cazes; unclassified G. P. A.

TABLE III. — *Road trials*

Classification	Group	No of marks	Actual load carried kg.	No of kilometre-tons carried	Consumption of type fuel per kilometre-ton carried kg	Calories used per kilometre-ton carried
1	Thornycroft	755	3357	416	226	1620
2	Lion	489	3515	436	250	1800
3	Viersen No. 1	486	3694	458	223	1606
4	Cazes	239	3534	438	229	1649
5	Viersen No. 2	77	3624	449	229	1649
Unclassified (*)	G P A	410	3660	454	223	1606

* Course finished on petrol.

Conclusions. — The Competition of the Automobile Club de France has shown that gas generators can be used for road-work. The following results were clearly shown. The consumption of calories per horse-hour which amounted to 5000, is quite double that of an engine running on petrol. In the same manner, the number of calories (about 1600) used per kilometre-ton carried by an engine running on low-grade gas is double that consumed by a petrol-driven engine.

The calory from solid fuel (wood, or wood charcoal) is much cheaper than the petrol calory, therefore, by using the former, a considerable saving, nearly 30 % is effected on the cost of the fuel. This saving is perhaps reduced to an extent that it is difficult to estimate, by a slight increase in the working expenses due to loss of engine-power and the necessity for more labour. With the improved engines, when in good order and handled by drivers who thoroughly understand them, it must be admitted that the increase in the up-keep expenses is very slight and finally that considerable saving can be effected by the use of low-grade gas. This has been already discovered by the industrial firms using these lorries.

In the Colonies and places where petrol is expensive and difficult to obtain, wood-consuming gas generators would be of great service, not only to motor traction but also in supplying motive power in general.

II AGRICULTURAL MACHINES AT THE BEGINNING OF 1923 — M. COUPAN passes in review the apparatus exhibited at the II^e Salon de la Machine agricole held at Paris in 1922, and at the 1922 Show of the Smithfield Club in London. He alludes also to the adaptation of the engines of tractors and the use of fuel other than petrol and especially of:

1) *Low-grade gas* — The great cost of petrol, in spite of a considerable decrease in the quality and the scarcity of fuel that can replace it, constitutes one of the causes that have brought about the crisis in motor-ploughing. The problem of making tractors running on fuel of another kind is complicated by the fact that the tractors are already built and the price paid for them is the limit of expense that the agriculturists were disposed to incur, therefore there can be no question of replacing the engines by others specially constructed to use the new kinds of fuel. An attempt

has therefore been made to run the existing engines on petrol, low-grade gas, etc.

Recourse was first had to paraffin, and the pressure was diminished by introducing wedges between the bottom of the cylinder and the shield, while the air was made damp by bubbling it through a water reservoir. English makers do not, however, like the air being previously moistened in this manner, and prefer that vaporisation should be induced by intense heating and slight compression of the mixture before ignition.

At the present time the use is suggested of gas-generators burning either charcoal, or dry wood mixed with charcoal. The author describes, in this connection, the results he observed in September 1922 when on a Titan tractor, with a wood-burning gas-generator made by the "Société française de Matériel agricole et industriel" of Vierson.

These trials, which were carried out under adverse circumstances, showed a total consumption of 120 kg. of chopped wood and 46 kg. charcoal in ploughing 1.3346 hectares. Reckoning the cost of the fuel at the very high figure of 300 fr. per ton of charcoal, and 100 fr. per ton of chopped wood, the cost would be 19 fr. per hectare. This estimate is however incorrect, owing to numerous sources of error; which if eliminated, reduce the fuel outlay to 8 fr. per hectare, ploughed to the depth of 18 cm. in a rather light soil.

If the cost of charcoal and wood be 200 fr. and 50 fr. respectively, the expense would be reduced to about 4.60 fr. per hectare, therefore the average net cost of the fuel required to plough to a depth of 20 cm. would work out at only 6 fr. per hectare.

On calculating the fuel cost per unit of volume of the worked soil (100 cubic metres), the figures 0.25 fr. or 0.44 fr. are obtained for low-grade gas, according to whether the estimate has been made on the basis of one, or the other, figure given above, whereas the most economical petrol-driven tractors used on the same ground consumed petrol to the value of 1.75 fr. and 3.06 fr. in breaking up the same amount of soil in the same manner. Low-grade gas obtained from wood, or wood charcoal, which the author proposes to call forest-gas, would therefore represent a great saving.

2) *Naphthaline*. — The engineers, MM. BALACHOWSKY and CAIRE, have devised a type of carburettor enabling naphthaline to be used in motor-engines. They exhibited this carburettor at the "Salon de Machines agricoles", it was fitted to GRAY tractors of the American Tractor Society and adapted to different types of semi-fixed engines. The above engineers estimate that crude naphthaline can be extracted from lignite and delivered at the farm at the present price of 25 to 30 fr. per 100 kg.

Although they are fully aware that naphthaline cannot be completely used, except by high or average pressure engines, MM. BALACHOWSKY and CAIRE consider that these latter engines are not yet sufficiently adapted to present requirements to justify the abandonment of the first types and therefore advises that agriculturists should continue to profit by the low price, lightness, simplicity etc. of the lower pressure engines provided they are well managed. The two above-mentioned engineers are of opin-

ion that it is not only necessary to melt the hydrocarbon in order to decant and filter it, but it must also be emulsified by means of a small amount of air at a temperature approaching ignition point, and kept constant, after which, the amount of air required for combustion should be added to this emulsion, care being taken to lose as little heat as possible.

In order to start the engine if it is cold, the carburettor is made to work for some minutes on petrol, or some other light fuel. When the required amount of heating is obtained, the naphthaline which is in the condition of hot vapour is introduced by suction; the aperture through which the petrol is introduced is then closed, which allows air to pass through the exit tube, thus providing another entrance for the air which, however, is not able to condense the naphthaline during the short course of the mixture on its way to the superheated chamber. Since the carburetted air and the fresh air always intersect at a wide angle a thorough mixture of the mass is produced.

If the dimensions of the superheated chamber are suitable to the power and output of the engine, a homogeneous mixture is obtained of a low enough temperature to permit of the cylinders filling properly.

The above apparatus can be used, not only for naphthaline, but also for gas-oil or mixtures of different kinds of petroleum with, or without, the addition of naphthaline. Although naphthaline does not mix in the correct sense of the term with these fuels, it would produce a noticeable effect, as even when added in quite small proportions it has the power of considerably retarding the stroke of ordinary petroleum engines and allows the pressure to increase to a perceptible degree before ignition.

The results of some experiments conducted by RINGELMANN, the Director of the Machine Trial Station in Paris, have shown that the engine of the GRAY tractor (4 cylinders 121×171 with 850 revolutions) consumed 0.56 litres to 0.76 litres of petrol per HP, and per hour, and from 0.50 kg to 0.68 kg. of naphthaline under the same conditions, with the BALACHOWSKY and CAIRE carburettor. Given the relative prices of petrol and naphthaline, these results are very interesting.

III. UTILISATION OF WOOD IN GAS-GENERATORS. — M. FICHET treats of this question from the chemical and the thermic standpoint in connection with the working of a gas-engine burning wood dried at 150°C . He shows that the heat liberated by the oxidation (into CO), of 1 kg. of carbon is 1313 calories, whereas the heat liberated by the dissociation of the water of constitution of the wood reached 1600 calories, to which must be added the 610 calories required to raise the mass of gas to 800°C ., the temperature necessary for the reaction $\text{CO}_2 + \text{C} = 2 \text{CO}$ to take place under good conditions.

In order to solve this difficulty, a certain amount of charcoal is added to the wood. To 1 kg. of carbon in the form of wood (wood dried at 150°C . contains 46.5 % carbon) 0.890 kg. of carbon in the form of charcoal should be added. The calorific power of the gas resulting from this mixture is about 1440 calories per cubic metre. These results are theoretical, but they differ little from actual results obtained.

In cases where it is difficult, or impossible, to procure the necessary

charcoal, the exhaust gas of the engine can be used for drying the wood at 250° C, but this temperature should not be exceeded, because the rise in calorific power is accompanied by the formation of volatile products and the consequent loss of heat. The gas-generator cannot work under such conditions, especially if the combustion is sustained by hot air obtained by the partial recovery of the heat carried away by the gas at 800° C. The calorific power of the gas thus obtained is as much as 1475 calories per cubic metre. The thermic yield amounts to 69 %. The heat of the exhaust gases of the engine (900 calories per horse-hour), is sufficient to dry, at 250° C, wood containing 33 % of water i. e., freshly cut wood. An engine can therefore be fed with such wood.

IV. THE GAS-GENERATORS AT THE DEUXIÈME SALON DE LA MACHINE AGRICOLE (Paris, Grand Palais). — The suction gas-generators for the engines exhibited at the Salon could be classed into two categories : 1) for feeding fixed engines ; 2) for supplying tractors and lorries.

1. The first may be classed according to the fuels used : gas-generator for English anthracite, or highly mineralised, French, or Belgian, coals : J. TOSELLO, at Liancourt (Oise), J. B. CATTEAU at Roubaix (Nord), Gas-generators using semi-bituminous fuels, saw-dust and wood waste, bark, peat or lignite. " Leon " made by PREZ CRASSIER, 29 Rue d'Angoulême, Paris — BOUTILLIER ET CIE., 33 Rue Basse d'Ingré, Orleans (Loiret), BIANDET-FORTIN, Montereau (Seine-et-Marne).

The latter firm exhibited a gas-generator with reversed combustion. It is of simple construction, able to supply a 10 HP engine of the " Rustic " type and uses wood refuse (mixture of saw-dust, shavings and pieces of wood). The apparatus has a generator without grating and consisting of a vertical holder lined with fire-clay and fitted with a cover for loading. The gas produced by the distillation of the wood waste passes out through the lower part of the generator, after traversing the incandescent reducing layer, and finds its way into a washer-cooler (sheet-iron cylinder filled with stones and surmounted by a metal basket containing sawdust that serves as a filter) ; thence the gas goes to the air-mixer and afterwards into the engine.

II. GAS-GENERATORS FOR TRACTORS OR MOTOR-LORRIES AND USING AS FUEL WOOD AND CHARCOAL.

1) The " Société française de Construction de Matériel agricole et industriel " at Vierzon (Cher) showed a self-reducing gas-generator working on pieces of twig mixed with charcoal (20 % in weight of the total charge). The amount of small wood varies according to its dampness, but does not exceed 1 kg. per horse-hour of work.

2) Société Cazes (27 Rue Saint Lazare, Paris) exhibited three tractors supplied with wood (Holt Tractor of 75 HP., Taureau Motor-Tractor 24 HP, Fordson 22 HP.). The author describes the fixing of one of the gas-generators to the fore-part of a Fordson tractor which is thus prevented from rearing. The gas-generator is placed in front of the radiator at a sufficient distance for the radiator to be well aerated with cool air ; it is mounted on a U-shaped iron chassis solidly fixed to the tractor by means a curved rim of angle-iron surrounding the lower portion of the

chassis and by an iron brace supported by the axis of articulation of the front wheels.

This generator weighs about 120 kg.; the whole space occupied by the apparatus has been greatly reduced as compared with that of the old types. The water reservoir is enclosed within the upper part of the generator, and forms a boiler through which the air passes in order to become saturated with steam. The purifying apparatus is all placed in one box of rectangular section and small size.

3) The Établissements Delhay et Mathieu (88, Rue Gonesse, Stains, Seine) have equipped an American lorry of the Liberty type with their charcoal gas-generator.

V. TRIALS OF LOW-GRADE GAS TRACTORS. — The Ministerial Decree of May 28, 1923 provided for trials of motor-cultural apparatus running on low-grade gas. These trials, which were organised by the "Comité Central mécanique", were held at Essones-Corbeille (Seine-et-Oise), during the autumn Motor-Culture Week. Four types of gas-generators working on charcoal or a mixture of charcoal and wood were entered.

1) BARBIER gas-generator (40 Rue Marboeuf, Paris) on Scémie tractor;

2) ETVA gas-generator (Rue de Gonesse, Stains, Seine) on Piocheux Motor-plough and on Renault tractor.

3) LION gas-generator (15 Rue Bonnefond, Lyon-Montchat, Rhône) on Austin and Mis-trel tractors;

4) Gas-generator of the Société française de Matériel agricole de Vierzon, Cher (on Amanco tractor).

Generally speaking, the gas-generators may be said to have acquitted themselves in a satisfactory manner.

F. D.

Methods of cultivation and Hydraulics.

734. Electro-Culture Work in Great Britain 1922-1923.

I. — *Fifth interim Report of the Electro-Culture Committee, Ministry of Agriculture*. London, 1923. — II. — *Journal of the Ministry of Agriculture*, Vol XXX. No. 4, pp. 321-326. London, 1923.

Experiments have been made by Prof. V. H. BLACKMAN, with winter wheat and barley (Rothamsted Experiment Station), with cabbages, swedes, mangolds and potatoes (Harper Adams Agricultural College), and with potatoes at Llandudno. Laboratory investigations were conducted at the Imperial College of Science, London. Electrical measurements were made to determine the influence of an electro-culture installation on electrical conditions to leeward and windward. Pot culture experiments were made with barley to ascertain the stage at which the discharge can most advantageously be applied, the correct duration of the discharge and the effect of normal atmospheric currents.

Results showed a very marked increase in grain yield, as much as 118 %, but only a small increase in total yield. The effect was such that it established a differential action of the discharge — namely that of

accelerating reproductive growth apart from vegetative growth, — an effect hitherto unsuspected. Electrification for the first, second and third month respectively, of the growing season gave in all cases an increase in yield, the second monthly period giving more than double that of plants not subjected to discharge. How far such an increase may be expected in other seasons remains yet to be determined. A current of lower intensity has been tried and if continued for the full period has been found equally effective, with the exception of the second month electrification system mentioned above. The removal of plants from the influence of the normal atmospheric current was accompanied by a slight reduction in yield.

Investigations have been in progress at Rothamsted to ascertain the best type of installation, the current required and the cost; the installation consists of 9 creosoted poles 24 ft. in length of which 6 ft. is sunk in the ground; the supporting wires are of rustless mild steel 125-130 yds. long, with 12 thinner wires of silicium bronze each 200 yds. long; the porcelain rod insulators are 18 inches in length. The cost of installation and erection (materials, carriage, labour, travelling expenses and supervision) was £52 for 5 acres i. e. about £10 per acre. It should not be taken for granted, however, that the cost of small installations can serve as a criterion of the cost in actual practice. The Agricultural Electric Discharge Company for example gives an estimate of £215 per 100 acres. The results from pot culture experiments are, however, important from the point of view of the installation required on an economic scale. It appears probable that lower level of wires would require a lower voltage. From the electrical measurements taken at Rothamsted on the wheat plot, on the stubble and on the field under installation, it has been concluded that with overhead wires whose distance apart is not much in excess of their height, fully half the current may be expected to reach the crop; also that a very considerable area surrounding the electro-culture area, especially on the leeward side, receives a discharge much in excess of that which passes normally between air and earth.

From the results obtained, there can be no question as to the economic application of electro-culture and the Electro-culture Committee consider that positive and economic conclusions will be reached by the end of 1925. It is proposed to concentrate attention solely on pot-culture, small plot experiments and laboratory investigations until that time when field experiments will be made, based on the scientific knowledge acquired in the preceding years.

M. L. Y.

735. Effect of Burning on Vegetation in Kansas Pastures.

HENSEL, R. L. (Pasture Specialist. Kansas Agricultural Experiment Station). *Journal of Agricultural Research*, Vol. XXIII, No. 8, pp 631-643, Plates 2, graphs 4. Washington, D. C., Feb. 1923.

Experiments were made on a 1500 acre tract of pasture land in Kansas at an altitude of 1200 to 1400 ft. which was too hilly for cultivation, to demonstrate clearly the actual effect of burning on vegetation and to dis-

prove the controversial opinions that it encourages weed growth and decreases the quantity of beneficial green feed. Areas were burned early each year, for comparison with control untouched areas; and records made with thermographs and quadrat chartings. The number of plants of each species of grasses, sedges and weeds, the temperature of the soil, the time at which growth began in the spring, and the yield of forage was ascertained in each case.

The results are classified as follows:

1) *Effect of burning on grasses.* — The total number of grasses was not decreased — there was, however, during 4 years a decrease in the number of sedges compared with an increase on the unburned plot. There was also a change in the general constitution of the experimental areas. Big bluestem (*Andropogon furcatus*) and *Poa pratensis* behaved as the sedges, but *A. scoparius* on the contrary, increased on the burned, and decreased on the unburned plots, also *Bouteloua curtipendula* decreased on both plots.

2) *Effect on weeds.* — The first year of experiment both plots were practically free from weeds. — The second year they were prevalent and from then onwards there was a decrease each year on the burned plot and an increase on the control plot. This applies to *Artemisia graphaloides* Nutt, *Erigeron divaricatus* Michx, *Ambrosia artemisiifolia* L., *Asclepias verticellata* L., *Ambrosia psilostachya*, *Erigeron ramosus*, and *Antennaria campestris*, in order of importance.

3) *Effect on soil temperatures.* — The object was to ascertain if burning results in a warmer soil early in the spring, and if so, whether this difference could be correlated with the growth of vegetation. Results indicate that mean maximum soil temperatures at a depth of 1 inch averaged 12 °F higher on the burned plot, and the mean minimum temperature 4 °F higher. At a depth of 3 inches the maximum and minimum temperatures were 3.6° and 4.2° higher respectively on the burned plot. This explains why growth starts earlier when old vegetation has been removed by burning.

4) *Effect on yield of hay.* — This was slightly higher on the unburned area but varied with seasons.

The author considers these results to be sufficient evidence as to the harmless effect of burning but advises that experiments should be made on a wider scale under varying conditions, with different types of vegetation and covering a longer period, before final conclusions can be drawn.

M. L. Y.

736 Water-Storage in America.

FRY, A. S (Morgan Engineering Co., Memphis, Tenn.). Water Supply and Irrigation Works, Wichita Falls, Tex. *Engineering News Record*, Vol 90, No. 25, pp 1080-1081 Map. 1. New York, 1923.

Works for the storage and distribution of water are in course of construction near Wichita Falls Texas. The operations, which will cost about

4 500 000 dollars, have been undertaken to supply the town with water and irrigate 110 000 acres of land in the valley of the Wichita River.

The height of the river is extremely irregular, periods of actual dryness alternating with great floods. The average annual rainfall is 27 ins. but it varies, being only 15.5 ins. some years, and the distribution of the rain is such that the river frequently dries up, with disastrous consequences.

A first barrage was made 40 miles above the Wichita Falls, and contains about 1 500 000 cu. yds. of earth, and is 7500 ft. long with a maximum height of 100 ft. The reservoir measures 13 miles by 3 ½ miles. The capacity at the level of the distribution channels is 500 000 acre-feet, and it covers a surface of 20 000 acres. Underneath the barrage, there is a cut-off trench filled with impermeable material. Under one side of the barrage run 6 cement channels. Four of these will be blocked as soon as the barrage is complete, but the object of the two others is to conduct the water to the diversion dam.

A study of the storms in the district of Texas has shown that heavy storms may be feared at the time the reservoir is full.

An emergency spillway will provide for extraordinary floods. The diversion dam is 4200 ft. long with a maximum height of 55 ft. above the river bed and a height of about 40 feet above the valley floor. The storage capacity is 45 000 acre-feet and it covers 3000 acres of land.

The distribution system is composed of three chief channels, one starting from the temporary barrage, and the two others branching off from the first.

R. D.

737. Relation of Crop Yields to Quantity of Irrigation Water in South Western Kansas.

KINCER, J. B., *Monthly Weather Review*, No. 50, Part 12, pp 647-649. Washington, 1922.

The South Western part of Kansas is very deficient in rain; over an area of about seven million acres, the annual rainfall is below 500 mm. Recourse has therefore to be had to irrigation and in the counties of Finney and Kearny alone, which are traversed by the river Arkansas, there are 100 000 acres of irrigated land; but this still leaves about 1.5 % of this territory to be provided for by drawing as much as possible on the subterranean water-bearing strata.

In view of the future large development of irrigation in this district, the Kansas Agricultural Experiment Station has founded a Sub-Station at Garden City, in the County of Finney, to study the solution of agricultural problems connected with irrigation, and especially for the study of crops suitable for irrigated farms and of the better and more economic use of water.

The following plants have been studied; millet, kafir, sumac, Sudan grass, wheat, barley and oats. Four plots A, B, C, D, were planted with each of these plants. All the plots were irrigated during the winter; throughout the summer, however, plot A was irrigated to the extent of keeping the

moisture content at 20 %, while that of plots *B* and *C* was kept respectively at 16 % and 12 %. Plot *D* was not irrigated at all during the season of growth.

During the five-year period, the millet produced the following amount of grain *A* - 5.37 bushels; *B* - 47.2; *C* - 40.7; *D* - 15.3. This plant is therefore able to use water to the fullest extent, and an increase in irrigation produces a corresponding increase in the crop. Further, the well irrigated plots proved much more resistant than the others to all unfavourable weather conditions.

Almost the same state of affairs was noticeable in the case of kafir, the plots *A*, *B*, *C*, *D* producing respectively : 33.7; 29.6, 23.8, 13.3 bushels per plot. Sumac, on the other hand, is unable to utilise large quantities of water; if over 37.5 mm. are supplied there is a decrease in the leafage.

Sudan grass also responds rather badly to irrigation and the results obtained are out of proportion to the water supplied. The crop should be left dry, or only irrigated to a slight extent.

Water appears to have less effect than meteorological factors upon the grain production of wheat, barley and oats, little advantage being gained by supplying more than 250 mm. The figures for the plots were *A* 21.8, *C* 19.3, *D* 13.4 bushels. G. A.

Machines and Implements.

738 Deep Ploughing with Machines.

THOMASSIN, M L (Labours profonds par des moyens mécaniques). *Comptes rendus de l'Académie d'Agriculture de France*, Vol 9, No 19, pp 516-523 Paris, 1923

M L. THOMASSIN has for some years used various machines for ploughing, with considerable success. The conditions under which this ploughing were done are explained. Three different types of implement were adopted in the tests: the Pavesi tractor with direct traction, the Dion double-engine tractor and the fixed electric windlass of the Electro-Magnetic Co. (C. E. M.).

The *Pavesi tractor* attached to a two-share plough with automatic lift and worked from his seat by the driver, ploughed 1 hectare of soil to a depth of 30 cm. with the consumption of 30 litres of petrol or other fuel and 5 litres of oil per hectare. This tractor is better suited for fairly light work than for heavy work in bad weather.

Dion double windlass requires a man for each windlass and a third for the plough. The speed of traction, 1.10 metre per second, allows 3 hectares per day, to be ploughed to an average depth of 0.30 m., all accidental hindrances being taken into account. The consumption of fuel per hectare varies from 30 to 40 litres of petrol; the amount of oil used is low. This windlass is unsuited to damp clay soils, and its weight (6 tons), makes it very difficult to move. It is generally hired out to work by contract at 10 francs per cm. of depth.

The C. E. M. fixed electric windlass consists of : 1) a movable transformation hut ; 2) a 6-ton electric windlass carrying two drums upon which 1100 m. of traction cable are rolled, the windlass being attached to the transformer by a flexible electric cable 750 m. in length ; 3) two anchoring carriages with automatic advance and fixed guide-pulleys. The ploughing can thus be done at a distance of 1200 m. from the wire supplying the current. The *Bajac* plough, which has been specially adapted to this windlass, can plough to a depth of 40 cm., although it weighs barely 1800 kg. Two men are sufficient to handle it, one guiding the plough and the other managing the windlass. This apparatus has worked without any mishaps in all weathers and on every type of ground. The amount of electric power used reached 120 kw. per hectare when ploughing to a depth of 25 to 30 cm., the minimum being 75 kw. The average contract price is fixed at 235 francs per hectare, not counting the time, or the teams used for change of position. One day and a half is the time that must be reckoned for changing the emplacement.

R. D.

739.. Small Double Two-Way Plough for Gardens.

MAURIN, G (Petit brabant-doublé pour jardins). *Journal d'Agriculture pratique*, Year 86, No 49, pp. 479-480, figs 2 Paris, 1923

This small type of double two-way plough, called the "Maraîcher", was specially constructed for the Bajac-France horticultural establishments. The position of the supporting wheels is regulated by a lever according to the depth to be ploughed, the axle being pushed to a greater or less distance from the point of the share, while another lever acts as a safety-catch.

The implement weighs about 75 kg and can turn a furrow 0.15 m to 0.20 m. wide.

R D

740 The Julien Sower-Roller.

Recherches et Inventions (Le semoir compresseur Julien) Year 4, No. 47, pp. 193-196, figs 2. Paris, 1923.

This invention owes its origin to the following important considerations :

a) The agricultural problem of the small farmer and the agriculturist working a large estate differs only in the number of seed-rows to be made.

In order to place within the reach of both types of agriculturists a mechanical appliance suited to their resources and yet meeting their requirements, it was necessary to devise a complete sower for a single line, so that the agriculturist could purchase as many of these separate parts as he needed and himself couple them together on the spot and at the distances apart most suitable for the seed he was using and the soil and means of traction at his disposal.

b) The chief conditions for good sowing may be summarised as follows: there must be no hollow ground beneath the seed (capillarity), hence the strip of loose soil that will receive the seed must be rolled (compression) although the soil under the seed should be left loose (chlorophyll function).

A single part of this new sower (see figs. 118 and 119) consists essentially of a wheel, 1, revolving freely on the ground and having an axle, 2, that supports a chassis, 3, itself carrying above and in the plane of the wheel, a hopper, 4, of which the bottom is provided with a distributor, 5, attached to a pinion 6, worked by a toothed-ring, 7, that engages with the wheel: the seed is carried before or behind, the wheel, as required, by means

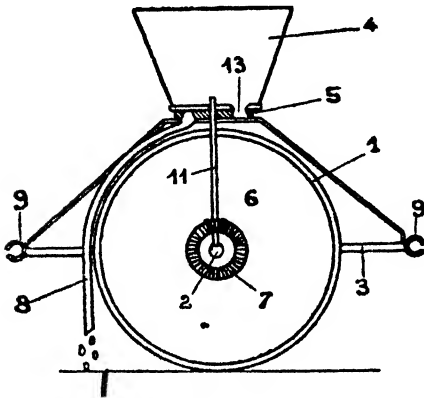


FIG. 118.

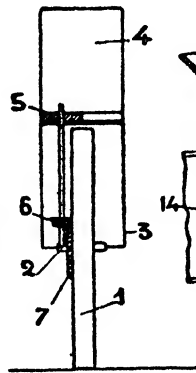


FIG. 119.

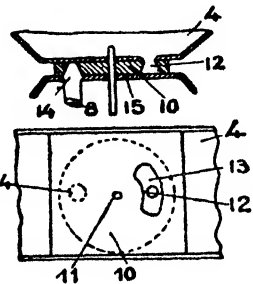


FIG. 120.

JULIEN SOWER ROLLER

FIGS. 118 and 119 Diagrams with partial sections of one part of the multiple sower (side view and front view).

FIG 120. Diagram giving details of distributor with reversible action.

of a series of pipes, thus the wheel plays the threefold part of trailing-wheel, starting-wheel and roller. The latter either exerts pressure simultaneously on the seed and the soil below, or else upon the soil before the seed is put in. Any suitable machine for apportioning and distributing the seed can be used, but the author has invented one characterised by its extreme simplicity (see fig. 120), and consisting of the following parts: a revolving plate, 10, worked by the square end of the axle, 11, of the pinion, 6, and carrying the measuring cups with truncated section, 12, that receive the seed through a hole, 13, at the bottom of the hopper 4, and carry it along by the rotatory movement of the plate letting it fall through the hole, 14 of the lower small plate, 15, into the pipes, 8.

By altering the dimensions of the cups, 12, it is possible to sow, in any given quantities, the various kinds of hard seeds from the largest to the smallest.

A larger, or smaller, number of cups per plate allows of the seeds being sown at any suitable distance along each row; thus, with a 1 to 4 ratio

of the pinions, the distance apart would be $\pi \frac{D}{4}$ (D being the diameter of the wheel), if the plate had only 1 cup, while it would be $\pi \frac{D}{8}$ in the case of 2 cups, and $\pi \frac{D}{12}$ in that of 3 cups. The characteristic of this type of seed distributor is that it is reversible and can work in both directions of its rotation, that is to say, during the forward and reversed action of the wheel controlling it. This new system is of special importance for cable-traction sowers, as it enables them to work backwards, and forwards without turning. It is also applicable to all the usual windlasses (electric steam, etc.) used in ploughing, and which have hitherto not been able to sow seed conveniently with the usual drills.

When provided with handles, a single part of this multiple sower (figs 118 and 119) makes a wheel-barrow sower, that can be drawn, or pushed, by hand (for market gardeners, horticulturists or country people).

If several parts are connected together and joined (fig. 118) to a single coupling-bar which may itself be attached to a fore-carriage (not shown), we have a multiple roller-sower in which each part performs its own work (of distribution or compression) independently.

If the several parts are placed side by side on the bar, the sowing-rows are 16 to 18 cm. apart. Above this minimum, the pieces can be arranged at any distances apart that are required without coupling on any more parts.

The threefold possibility of being able to regulate the distances between the seeds in a row, to alter at will the space between the rows, and to change the quality, or even the kind of seed sown from one row to another seems to offer to the practical agriculturists and still more to Experiment Farms and Agricultural Stations, new opportunities of great importance, as for instance in the selection and crossing of seeds, in determining the comparative effect of fertiliser and in combining forage crops, and sowing cover crops. The great industrial interest attaching to this new invention depends upon the fact that the separate pieces can be standardised and made in series on a large scale, so as to put within the reach of the many small farmers the means of doing their sowing by machine which has hitherto been impossible.

741. A New Potato Planter.

PASSELÈGUE, G. (Chef de travaux à la Station d'Essais de Machines). *Journal d'Agriculture Pratique*, Planteur de pommes de terre. Year 87, No. 17, pp. 340-341, figs. 2. Paris, 1923.

The great problem to be solved in designing a potato-planter is to devise an apparatus that can take up one potato at a time and not injure the tuber during the operation.

The first of these requirements is fulfilled by the BAJAC planter which is provided with a distributor composed of chains with cups c (see figure 122),

that take up the tubers from a hopper *T* and carry them back to a tube through which they fall from a little height into the bottom of the furrow.

The cups are filled as they pass vertically through the hopper *T*, while an inverted Archimedian screw, *V*, which is parallel to the axle, pushes the potatoes continually towards the chains. The hopper is divided into two compartments by a vertical partition *A*; one of the compartments contains the mechanism just described, and the other is filled with the potatoes, the bottom of this division is inclined to allow the potatoes to pass down easily, and a shaker to prevent the tubers obstructing one another.

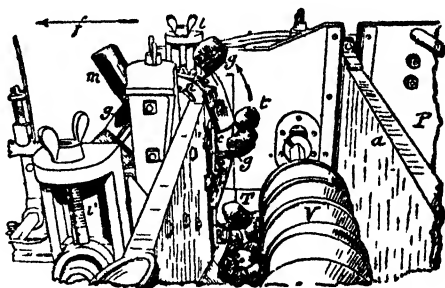


FIG 121 — BAJAC Potato Planter

In order to insure that each cup shall only take up one potato at a time, the following original method has been devised. The average capacity of each cup *g* is sufficient to contain two potatoes if necessary, but each cup is provided with a metal hand *m* which is below it in the ascending portion of chain being pressed against the latter so as not to interfere with the following cup when it passes the upper pinion *n*. The cup, balance hand *gm* and the lower extremity of the hand *m* all swing clear of the chain *c*, thus letting the extra potato *t* fall back into the hopper *T*.

As the chain continues its course, the mouths of the cups and the openings of the hands are inverted, so that the tubers fall from each cup in succession to be caught by the hand beneath. R. D.

742. A New Method of Feeding Threshing-Machines.

The Royal Show at Newcastle *The Engineer*, Vol CXXXVI, No 3523, pp 17-18 London, 1923

An ordinary threshing-machine requires at least two on the stacks, one to receive the sheaves and cut the wisps binding them, and another to feed the machine. With a view to saving some of this labour, WILLIAM FOSTER and Co. have devised an automatic feeder which needs only one man on the stack to deliver the sheaves. This apparatus consists of an endless canvas revolving between two partitions and bearing at intervals transverse series of teeth to transport the sheaves. The wisps binding the sheaves are cut by rotating discoidal blades. At a little distance, there is a cylinder also fitted with teeth arranged at regular intervals on its circumference. This acts like a comb upon the sheaves and quickly removes the upper layers of straw (as it turns much faster than the travelling canvas), which are thus dragged forwards in front of the lower layers. The removal of the upper layers carries forward the centre portion of the mass to some extent, so that the straw reaches the feeding cylinder regularly and with-

out interruption. A regulating mechanism prevents too much straw passing at a time, and if any sheaf is too large, there is a temporary slowing down of the circulation until the cylinder-comb has reduced the sheaf to the right size. The apparatus is kept in equilibrium by a lever, and the feed-hopper sinks gradually as the stack diminishes. The rapidity of the travelling canvas is such that it delivers 25 to 30 sheaves per minute.

When one heap is finished, the apparatus can be placed on the top of the threshing-machine where it takes up little space. Its total weight is about 6 cwt. and the power required for driving is 3 HP. R. D

743. Apparatus for the Mechanical Preparation and Sorting of Seed-Rice.

TARCHETTI, A., CELORIA, D., FANCIULLI, O., and POZZI, G. Relazione sul concorso internazionale di trebbiatori, pulitori, separatori e cernitori per la preparazione e selezione meccanica dei risi da seme. *Il Giornale di Riscoltura*, Year XIII, No. 8, pp. 113-119. Vercelli, 1923.

In the autumn of 1922, the Rice-Growing Station at Vercelli inaugurated an international competition for apparatus for the mechanical preparation and sorting of seed-rice. The following were entered and the trials were carried out from October 1922 to February 1923.

Special threshers for seed-rice to be used for the sheaves after the crop is carried :

1) Drum-beater adapted for seed-rice, made by the Società Anonima Officine Bergoni (D. M. I. B.) of Melegnano. In these machines, the sharp points of the "English" threshers and the combs of the ordinary rice-threshers are replaced by simple L-shaped bars of iron, in order to thresh the grain more thoroughly.

2) Auto-feeder for sheaves and separator-dresser of seed-rice also made by the D. M. I. B. This consists of a straw-shaker, and straw-carrier eccentric which work in front of the beater of the thresher.

3) Semi-fixed, motor-driven cleaner for newly-harvested rice made by the firm of Ing. P. Cattaneo and Sons of Pavia. This is separate from the thresher and has only one fan.

4) Semi-fixed, motor-driven cleaner for newly-harvested rice made by the firm MORANDI and MINGHETTI of Mortara. This is placed directly under the thresher and takes the place of the usual sieves. It does good work.

5) Transportable, motor-driven rice-cleaner made by the above-mentioned O. M. F. B. firm. It is mounted on 4 wheels and provided with 2 fans, and cleans the grain almost perfectly, even when the rice is very wet and dirty.

Rice-cleaners for freeing dry rice from foreign bodies and impurities.

6) Semi-fixed, motor-driven cleaner made by the firm Umberto Artioli e C. of Vercelli.

7) Semi-fixed, motor driven cleaner made by the firm Ing. P. Cattaneo and Sons of Pavia.

8) Semi-fixed, motor-driven cleaner made by the Officine Bergomi

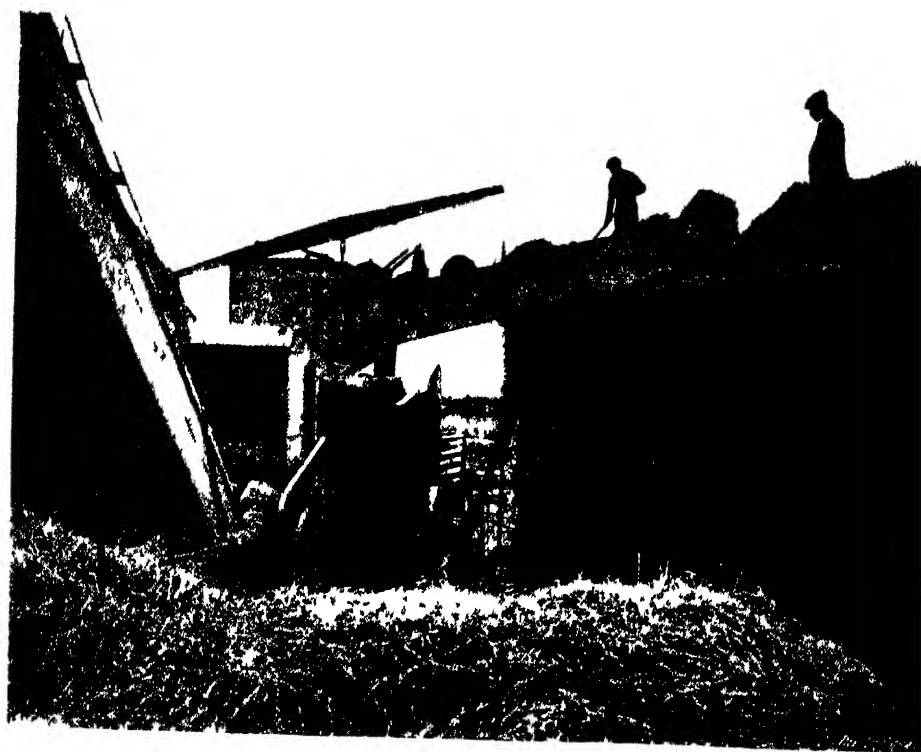


FIG. 1. EMBANKMENT

of Melegnano. These are generally good cleaners for ordinary rice and are built for work on a large scale.

Separators, or sorters, of seed-rice. — For separating the seeds of foreign varieties of rice, or defective and bad grains, from seed-rice that has been already winnowed and cleaned.

9) Semi-fixed, motor-driven separator made by Avv. Giuseppe Bonarda of Casale Monferrato. This consists of a series composed of parallel, cylindrical, metal bars arranged either flat (*trabatto*) or spirally (*tamburo*) so that the grains gradually fall into the space between two contiguous bars, and are forced by the action of gravity to pass downwards, their long axis being perpendicular in every case. This simple arrangement has proved very successful.

Original monographs, or designs.

Describing or illustrating, new methods of carrying out work of the class described above.

10) Design of special, movable thresher for seed-rice exhibited by the firm of Umberto Ortioli e C. of Vercelli, for re-cleaning rice which has been already cleaned before bagging. It is fitted with a wooden suction pipe that goes down to the level of the lowest sieve of the thresher.

F. D.

744. Carter Disk Separator for Sorting Grain.

Révolution dans le système de triage des grains. *La Meunerie française*, Year 39, No. 403, pp. 253-257, figs. 7. Paris, 1923.

The "Carter" disk separators (Agents MM. Henry Simon Ltd) work on quite a different system from sorters. The separation is effected by a certain number of disks of hardened cast-iron. The disks are provided on both sides with small pockets, the lower portion of which slopes inwards like the cups of an elevator. These disks are placed vertically 6 cm. apart on a shaft making 55 to 66 revolutions per minute. To the axle of the disks are affixed strakes forming a sort of transporting screw which sends the mixture from one disk to another until it reaches the rear of the machine beneath which is a hopper. The whole apparatus is enclosed in a metal cover.

F. D.

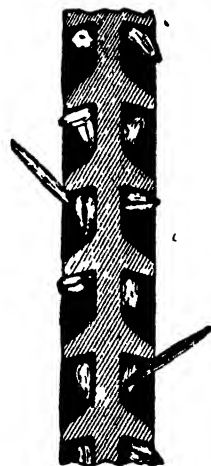


FIG. 123.

FIG. 124.

CARTER Disk Separator

Fig. 123. Section of a disk showing pockets of ordinary size. These pockets catch the wheat and throw out the oats, barley straw, etc.

Fig. 124. Section of a disk for round grain. These pockets catch round seeds that are smaller than wheat.

[744]

745. Barbieri Seed-Separators for Freeing Grape-Skins from Pips.

SANNINO, F. A. Utilizzazione dei vinaccioli e loro separazione dalle bucce. *Revista di Ampelografia*, Year IV, No. 9, pp. 144-145, figs. 3. Alba, 1923.

The firm of BARBIERI Bros. at Modena makes various types of machine (worked by hand, or engine) for separating grape pomace into skins and pips. The skins are crushed by a mechanism essentially similar to that of a threshing-machine; after this, they pass into a series of sieves the lowest of which is surrounded by a current of air generated by a ventilator. From 25 to 40 % of pips can be recovered from the sifted grape-skins

F. D.

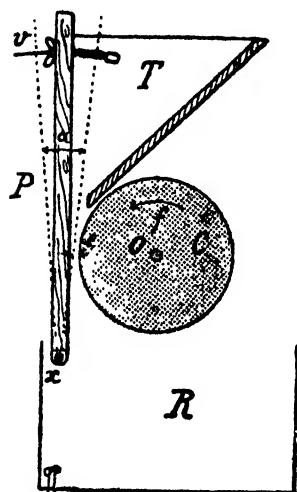


FIG. 125. — Machine for extracting kernels from nuts of *Butyrospermum Parkii*.

- T = hopper
- C = wooden cylinder
- f = rotation
- P = counter-block
- R = receiver
- v = regulating screw
- x = horizontal axis.

746. A Machine designed for extracting the Kernels from the Nuts of *Butyrospermum Parkii*.

PASSELEGUE, G. (Chef de Travaux à la Station d'Essais de Machines). *L'Agronomie Coloniale*, Projet d'une machine pour extraire les amandes des noix de Karité. Year 8, No. 64, pp. 105-106. Paris, 1923.

The natives in the Sudan extract the kernels of the Karité nut (*Butyrospermum Parkii*) by a very slow manual process yielding meagre results. They place the nuts in the oven to separate the kernel from the shell to which it no longer adheres, but the shell is brittle and easily broken.

The author has devised a machine which, being strong and cheap, could well be put into the hands of Sudanese workers.

The principle upon which it works is as follows, the nuts in the hopper T are drawn along by the rotation (f) of a wooden cylinder C till they lie between it and the counter-block P. the distance between the two being gradually diminished so as to be more than the diameter of the kernel, to avoid injuring it, and less than the diameter of the nut. The distance is adjusted by a

regulating screw v that makes the counter-block P revolve around its horizontal axis x.

The operation can be repeated, two different adjustments being used after the nuts have been sorted.

R. D.

subsequently to a third brush. Instead of using brushes with progressively longer bristles, the distance between the axes of the rollers in the direction the fibre moves may be progressively decreased, which would allow of the use of interchangeable brushes.

This apparatus gives very clean fibre, it is inexpensive and can be worked by hand, or by an engine. By employing his new invention Mr. MARKS finds himself in a position to organise the use for industrial purposes, of all the jute growing wild in South Africa, and has undertaken to hire out the apparatus to jute cultivators. R. D.

748. A New Type of Apple-Crusher.

TRUELLE, A. (Membre de l'Académie d'Agriculture de France). *La Vie Agricole et Rurale* La division des pommès par le broyeur-vapeur. Year 12, No. 17, pp. 286-288, figs. 5, tables 2. Paris, 1923.

This apparatus is both a crusher and a grater. It is an ordinary crusher with a single cylinder with movable blades that go in and out during its rotation. The blades have triangular grooves and come tangentially against a plate which is also grooved. The cylinder makes 60-100 revolutions per minute. The new apparatus pounds the apples finer than an ordinary crusher without, however, reducing them to such minute particles as a grater. Owing to the lower rate at which the cylinder moves, the product is not like the pulp obtained from the rapidly revolving grater, and the juice does not exude thick and full of sediment. The machine is provided with an automatic arrangement for removing the pips, so that the teeth of the blades are protected from any injury. The firm of Simon frères (Cherbourg, France) will transform all old apple-crushers in use into the new type of crusher-grater. R. D.

749. Cotton Dusting Machinery for Control of Cotton Boll Weevil.

JOHNSON, E., HOWARD, S. T., and COAD, B. R., *U. S. Department of Agriculture, Farmers' Bulletin* No. 1319, pp. 1-19, figs. 4. Washington, D. C., 1923.

A revised and completed edition of a former Bulletin published in 1920, entitled "Dusting Machinery for Cotton Boll Weevil Control" (*Farmers' Bulletin* No. 1098).

Dusting cotton plants with powdered calcium arsenate has proved to be the most economical and satisfactory method of poisoning the boll weevil. Success however, depends largely on the use of suitable machinery. This bulletin tells the prospective buyer how to select a type of dusting machine suited to conditions and requirements on cotton plantations (distinct from the fruit spraying apparatus). A large number of models, manufactured by over 20 firms are on the market and many more are being developed. Machine types are classified according to the following characteristics: 1) hand gun; cheap method and easily transported into somewhat inaccessible places; 2) saddle gun, operated by hand cranking; sprays two rows simultaneously; 3) one-mule machine;

4) cart duster (2-horse duster on 2 wheels); 5) power duster, for large areas.

Owing to the necessity of night operations, the question of lighting equipment is very important. It is estimated that the total cost per acre, including machine depreciation, machine upkeep, manual labour, and mule labour amounts to 20 to 25 cents (with either of 1-mule or cart types of machines) and somewhat higher for hand guns.

F. D.

BIBLIOGRAPHICAL NOTES.

750. THOM, C C and HOLTZ H F. Western Dry Farming Methods *Sugar*, Vol XXV, No. 6, pp. 318-320 New York, 1923

The article gives a general description of dry-farming methods and supplies information useful for new settlers taking farms in dry belts, and which should help them to develop their land to the best advantage.

W. S. G.

751. GREGORY W B (Irrigation Engineer Tests of Drainage Pumping Plants in the Southern States *United States Department of Agriculture, Bulletin* No 1067, 54 pp tables 40, figs 8. Washington, 1922

In the districts of South Louisiana, the extensive sugar-cane cultivation has caused a dearth of land which has been remedied by draining the marshes by a system of pumps wherever the level of the ground was too low to allow of drainage by gravity. So great has been the demand for the marshland that all systems of drainage pumping plants have been employed, from the most antiquated to the most modern The Bulletin deals with the following questions Absorption and discharge pipes — Power sources for pumping plants — Tests of the different systems — Cost of the work.

R. D.

752 ALEXANDER, W P Monograph issued by the Experiment Station of the Hawaiian Sugar Planter's Association The Irrigation of Sugar Cane in Hawaii, pp 90, figs 64, Honolulu, 1923

This is an exhaustive and well illustrated treatise describing the systems of irrigation which have given such satisfactory results in the Hawaiian Islands and their comparative costs per acre.

W. S. G.

753 STILES, C W and CROWHURST, H R (Hygienic Laboratory U. S., Public Health Service) Movement of *B coli* in Groundwater and Pollution of Wells *Engineering News Record*, Vol 91, No 11, p 475, Chicago, 1923.

A brief account of the results of exhaustive investigations of the movement of faecal micro-organisms in the water of the subsoil. These researches were made in connection with the enquiries instituted by the Public Health Service as to the best means of using night-soil in the country

districts, and they show, among other things, that *B. coli* moves freely in groundwater, unused wells should therefore never be employed as pits for faecal matter, nor should privy drains be excavated in permeable strata. Further, it is necessary not only to protect wells at the surface, but also to make impermeable the portion of the well between the maximum level of the water and 30 cm. below the minimum level of the water. F. D.

754. LA RUE P. (Ing. Agr.). La culture mécanique des pommes de terre. (Potato Planters) — *La vie agricole et Rurale*, Year 12, No. 16, pp. 266-268, figs. 5. Paris, 1923.

The author gives particulars of 3 potato-planters (H. Wilson and Krupp system), and of the Lang potato planter and lifter. A description is given also of the regulation of forked lifters, the results of experiments made in England with potato-lifters, and the requirements to be fulfilled by potato sifters and a washer provided with a pump. R. D.

755. ROETHE, H. E. (Associate Development Engineer, Bureau of Chemistry). Grounding Cotton Gins to prevent Fires. *United States Dept. of Agriculture, Department Circular 271*, pp. 4, figs. 1. Washington, D. C., 1923.

In some seasons the loss from cotton-gin fires in the United States amounts to nearly \$1 250 000. Investigations have led to the conclusion that static electricity is frequently the cause of fires during the ginning process. The simultaneous occurrence of three conditions:— low humidity, dry cotton and dirty cotton is essential for the existence of high electrostatic charges in the gin.

A grounding system, inexpensive and effective for preventing fires, combined with cleanliness and proper upkeep, is recommended. The article gives full details concerning the installation and completes the information contained in *Department Circular 28*. The effectiveness of this system is now recognised by Insurance Companies who allow reduced insurance rates in the factories where this system has been adopted.

R. D.

756. MAGNE, CH. Micro-dynamomètre enregistreur pour essais de traction des fibres textiles. (Micro-dynamometer for testing fibres). *Bulletin de l'Agence générale des Colonies*, Year 16, No. 183, pp. 462-465, figs. 1. Paris, 1923.

Description of the apparatus made and tested by the author, in the "Laboratoire des Productions coloniales du Ministère des Colonies de France". Modifications can be easily made, so that consecutive readings are easy and accurate. F. D.

757. ORNER, A. J. The Manufacture of Roofing Tiles on the Farm. *Department of Agriculture, Salisbury, Rhodesia, Bulletin No. 453*, pp. 8, fig. 7. Salisbury, 1923.

A description of the manufacture on the farm of hand-made tiles, the most suitable roofing material in Rhodesia, with practical suggestions relative to moulding and drying, burning and preparation of the roof.

R. D.

758. VOSHELL, J. T. and TOMS R. E. (Bureau of Public Roads). Portland Cement Concrete Roads. *United States Department of Agriculture, Bulletin* No. 1077, pp, 67, tables. figs. Washington, D. C., 1922.

This Bulletin gives the most recent information as to modern methods of making and repairing concrete roads, the materials employed, the repairs necessary, and the net cost of construction.

759. BEATTIE J. H. (Horticulturist) Greenhouse Construction and Heating, *U. S Department of Agriculture Farmers' Bulletin* No. 1318, pp. 35. figs 20, tables 6. Washington D. C., 1923.

According to the statistics of 1919, over 77 000 000 dollars' worth of greenhouse produce was raised that year, the area under glass being about 3250 acres. This bulletin deals with the construction and management of greenhouses in the following chapters :

1) Importance of the greenhouse industry ; 2) Suitable places for their construction ; 3) Installation ; 4) Types of greenhouse ; 5) Size and proportions of greenhouses ; 6) Materials and different parts of the greenhouse ; 7) Ventilation ; 8) Glazing and painting ; 9) Heating ; 10) Water-supply ; 11) Beds and passages , 12) Some greenhouses suitable for beginners.

R. D.

760. RINGELMANN, M. Silos américains *Jouanal d'Agriculture pratique*, Year 37, No. 38, pp. 233-237, figs 5 Paris, 1923

An account of experiments made in France since 1853 with underground, masonry and exposed silos, and a description of the principal types in general use in the United States, constructed of wood, brick, reinforced concrete or metal.

F. D.

761. LARUE P De bonnes clôtures pour nos herbages. *Revue de Zootechnie, Revue des Éleveurs* Year 2, No 3, pp 246-259, Paris, 1923.

Description of the various types of fencing, for fields, in actual use in France (with illustrations).

R. D.

762. POUND, R. T. Fences for Stock-Farm and Ranch. *The Breeders Gazette*, Vol LXXXIII, No 22, pp. 747-748 figs. 3. Chicago, 1923.

Comparison of the different forms of fencing and material employed.

R. D.

AGRICULTURAL INDUSTRIES.

*Plant Products.***763. The Transformation during Fermentation of the Arsenic present in the Juice of Fruits (1).**

BOSSELMANN, H., and KOCH, A. (Chemisches Laboratorium des Reichsgesundheitsamt, Berlin). Über Vergärung arsenhaltigen Obstsäfte. *Zeitschrift für Untersuchung der Nahrungs und Genussmittel*, Vol. 46, No. 1, pp.10-33. Berlin, 1923.

This question is of special interest in the case of making wine from grapes that have been treated with arsenic compounds for the control of *Conchylis ambiguella* and *Eudemis botrana*. The author's brief account of the previous work done in this field is provided with a bibliography of 33 publications and describes their experiments: 1) research on the formation of arsenical compounds formed during alcoholic fermentation; 2) fermentation tests with nutritive salts; 3) experiments on the effect of sulphuretted hydrogen on the separation of arsenic during fermentation; 4) fermentation tests with musts (apple and currant); 5) fermentation tests with, and without, the addition of sulphur; 6) adsorption experiments with colloidal sulphide of arsenic. The results obtained are summarised as follows:

In the fermentation of the juice of fruits containing arsenic, the percentage of arsenic decreases during the passage from must to wine, as some of the arsenic is deposited with the ferments. No volatile arsenic compounds, not even hydrogen arsenide, are formed during fermentation.

The separating out of some of the arsenic in the ferments is connected with the vital activity of the latter, and only takes place in the presence of sulphuretted hydrogen produced by biological phenomena. An intensified evolution of sulphuretted hydrogen is favourable to the liberation of the arsenic.

The precipitation of the sulphide of arsenic in the natural juices of fruit cannot be counted upon, for the sulphuretted hydrogen produced with the fermentation gases is more likely to transform the arsenic present in the fermenting mass into *colloidal sulphide of arsenic* which is absorbed by the cells of the ferment. Thus, the latter helps in two ways to bring about the partial removal of the poison. This it does partly by biological means, in the course of its own development, and partly by physical means, for it contributes, as a result of surface action, to the abstraction, from the fermenting mass, of the sulphide of arsenic that is then in a colloidal form. In conformity with the quantitative relations in adsorption phenomena, the lower the concentration of the arsenic in the must, the higher is the relative amount of arsenic found in the ferment.

(1) See R. 1922, No. 1217. (Ed.)

If copper is present at the same time, the ferments contain a higher percentage of arsenic, provided a sufficiently large amount of sulphuretted hydrogen is produced. In this case, the copper is also precipitated as a sulphide, but it all separates out with the ferments.

The precipitates of fish glue and tannin almost entirely absorb the sulphide of arsenic, but arsenious acid is not absorbed by them to any appreciable extent.

Under the experimental conditions (fermentation in balls), the presence of arsenic hindered fermentation, even if the amount of arsenic was very small (5 mgm. per litre). This inhibiting action, however, decreased greatly in the presence of small quantities of copper. F. D.

764 Utilisation of Small Grape Clusters.

HUGUES, E (Chef de travaux à la Station œnologique de Montpellier). *Bulletin agricole de l'Algérie-Tunisie-Maroc* (Note sur l'utilisation des grappillons) 2nd. Series, Year 29, No 9, pp 150-161. Algiers 1923

Results of an experiment made in 1922 by a vinegrower in Montpellier and by the author, to test the utilisation of small bunches of grapes for extraction of sour juice and the subsequent preparation of a wine which may be mixed advantageously with other wines rich in colour and slightly acid

1000 kg of grape clusters collected from 1 hectare gave 600 litres of sour juice, which fermented in the usual way and gave a wine strength 5.6° (Mallegand), 32 gm. per litre of dry extract and 19 gm. (tartaric acid) (18 %) total acidity. It has been estimated at a rate of 37 90 gm. per hectolitre of alcohol, the cost for harvesting and wine making 17 33 fcs.

Where the small bunches of grapes in a vineyard are numerous, it is recommended therefore to collect them for the sour juice to modify the sale of the very ripe fruit F. D

765 By-Products of Superior Quality Grapes for Export into "Dry" Countries.

VINCENS, I (Directeur de la Station Œnologique et du Laboratoire Régional Agricole de Toulouse) Utilisation des raisins fins de Gironde sous une forme pouvant être exportée dans les pays secs *Revue de Viticulture*, Year 30, Vol LIX, No. 1524, pp 173-179, No 1252 pp 190 194, figs 6. Paris, 1923.

Experiments made by the author at the "Station Œnologique de Toulouse" (France) in accordance with the propositions put forward by the "Office régional agricole du Sud-Ouest", in April 1922 viz. "to select from amongst the known processes, the methods most suitable for the utilisation of superior quality grapes in the Gironde for exportation and consumption in "dry" countries.

The problem has been studied from the following standpoints: 1) the concentration of the must; (the smaller factories carry out the clarification by decantation and subsequent neutralisation of acidity by addition

of calcium carbonate at reduced pressure, temperature 35°-40° C. concentration 25°-35° Beaumé). Some of the apparatus employed with success are described ; 2) Conversion of concentrated musts to a solidified form adapted to the preparation of "grape sweets" and "grape soda". The must when diluted with 2 or 3 times its volume of water and inoculated with a ferment should be suitable for the preparation of light wines.

F. D.

766. Production of Alcohol from Juice of *Agave sisalana* (1).

BRUNO, F. and SORGES, F. *L'Agricoltura coloniale*, Year XII, No. 5, pp. 161-169 Florence, 1923

In view of the possible substitution of petrol in non-producing countries by industrial alcohol obtained at a low cost, the authors have undertaken investigations at the R. Giardino Coloniale, Palermo with *Agave sisalana*, with regard to the fermentation of the juice of this plant which grows profusely in Sicily

Leaves collected in December, April, and July and extracted by hand pressure, gave the following proportions of juice, 48 % to 50 %, 52 % to 50.8 % containing respectively 4.89 to 6 % ; 6.10 to 6.38 % ; 4.40 to 6.65 % of dry extract. The minimum percentage was obtained from leaves cut and pressed the same day and the maximum from leaves kept in the shade 8 days after cutting. The difference may be due to concentration caused by evaporation of water (6-9 %) and decomposition of the leaf.

An analysis of the juice showed a density (at 15° C) varying from 1.014 to 1.037 and a sugar content, expressed as glucose, of 1.008 % to 2.96 %. The author supports the statement made by HERELLE relative to the increase in density and sugar content after conserving for some days ; this, however, varies with the season and in Sicily the maximum percentage is said to be obtained from leaves collected between August and early December. Further analyses made in the R. Ufficio Agrario della Tripolitania confirm the above results (density at 15°, 1.0105 ; sugar % 1.482).

The disadvantage to the high acidity has been remedied by the addition of calcium carbonate and 5 % ammonium phosphate. An average of 5.66 to 6.1 c. c. of anhydrous alcohol per litre of juice has been obtained. Results encourage further work on an industrial scale.

The average weight per leaf is estimated at 800 gm. and this should give 50 % i. e. 400 gm. of juice. Thus, 25 leaves per plant should give 10 litres of juice per year and it is consequently estimated that 2 000 plants per hectare should furnish 20 000 litres of juice. This amounts to 2.27 % of reducing sugars and 454 kg. per ha. of fermentable sugar, corresponding to a yield of 166.9 litres of alcohol (per hectare).

F. D.

(1) See R. 1918, No. 904. (Ed.)

767. Cholam (*Andropogon sorghum*) as a Substitute for Barley in Malting.

NORRIS, Dr R. V. and VISWANATH, B. *Agricultural Journal of India*, Vol XVIII, No. 4, pp. 362-373, tables 7. Pusa, 1923.

The experiments reported in this paper have as their object a comparison between *cholam* and barley malts for brewing or other purposes.

The chemical composition of the two grains is very similar except that the fat content of *cholam* is double that of barley (4.14 : 2.05). Malts were prepared from 18 varieties of *cholam* and the amount of extract given by each was determined; the best varieties gave practically the same yield as barley.

Germination for 72 hours with a moderate supply of moisture gave the best results.

The saccharification power of *cholam* malt seems to be high and the diastatic power comparatively low, but the deficiency of diastatic power is a relative one only, as eventually the sugar production from *cholam* malt catches up and often surpasses that from barley.

The authors see no reason why *cholam* should not replace barley malt for many purposes and its use is suggested for the production of malted foods

W. S. G.

768. The Wheats of South East Russia; their Milling and Bread-making Properties.

CINCO CINGAS. К. М. Пшеницы юго-востока России в мукомольном отношении — *Труды по прикладной ботанике и селекции* — с х Ученого комитета народного комиссариата земледелия и животноводства, приложение 24, pp. 1-53 Petrograd, 1922.

This paper gives the results obtained by the author from a series of researches undertaken with the object of studying the milling and bread-making properties of the wheats of South-East Russia.

In order to obtain the most comparable data, the author employed pure lines from the Government Agricultural Stations of Saratov and Samara; three varieties of soft winter wheat (*Triticum vulgare*); five hard March wheats (*Tr. durum*), thirteen soft March wheats (*Tr. vulgare*) the black, March Persian wheat (*Tr. Persicum* Vav.) and one *Tr. dicoccum*.

The milling qualities of the varieties examined differed greatly, some of them milled easily and quickly, whereas others had to be ground repeatedly in order to separate the flour from the bran. Of the latter type we may mention *lutescens* × *graecum*, a hybrid produced at the Agricultural Experiment Station of Saratov, and the black Persian wheat (*Tr. Persicum* Vav.). The following on the other hand, mill easily, *Tr. vulgare* v. *Hostranum* No. 237, and *Tr. vulgare* v. *lutescens* No. 329, both autumn wheats from the Saratov Station, and the hard wheats *Tr. durum*, v. *melanopus* and *coerulescens*.

As regards the consistence of the flour, the varieties investigated may

be divided into three groups: semolinas (granular), strong flours (intermediate) and weak flours.

All the hard, and some of the semi-hard, wheats gave granular flour, while the weak flours were obtained exclusively from the soft wheats.

It may be remarked that there is no relation between the consistency of the flour and the greater or less, facility with which it can be milled, thus, for instance, *Tr. durum* v. *melanopus* and v. *coerulescens* give a granular product that mills easily, whereas *Tr. persicum* which is also hard and flinty needs repeated milling, to reduce it to the required degree of fineness.

The flour may be of two colours: yellow and brown (from snowy whiteness to a light shade of brown). The following wheats yield yellow flour, *Tr. vulgare* v. *albidum* No. 804 from the Saratov Station, *Tr. durum* v. *hordeiforme* No. 432; *Tr. durum* *coerulescens* and *melanopus*.

With equal contents of organic substances, the flour yield varies with the size of the grain, and even for the same variety within very wide limits. Thus *Triticum durum hordeiforme* from the same lot produced 86 % from coarse grains, 75 % from medium, and 46 % from small, the organic content present being in each case 2.5 %.

In the bread-making tests, and the preparation of the dough, flour patents (quality 75 %) were used to which had been added sugar, salt and yeast, 500 cc. of water being introduced.

The various qualities of wheat behaved very differently, a somewhat variable amount of patents being necessary in order to obtain dough of a given consistency.

On an average, all the semolinas and strong flours gave 160 gm. of dough per 100 of patents while the soft flours only gave 152 gm. of dough.

A similar difference was met with as regards the weight of the bread. The semolina varieties make 143 gm. per 1000 gm. of patents, strong flours make 141 gm. and weak flours 134 gm.

As regards volume, however, the weak flours take the first place with 401 cc., next come the strong with 370 cc., and lastly, the semolinas with 361 cc. (per 100 gm. of flour). *Triticum durum* v. *melanopus* gives the greatest volume of bread and the largest amount of dough. The soft variety *Tr. vulgare* v. *hortianum* No. 237 from the Saratov Agricultural Station gave the maximum volume, 499 cc.

In many Russian mills, it is the practice to mix hard wheats with soft wheats, for according to the general opinion, this is the best means of obtaining good results in bread-making. The test experiments made by the author have fully confirmed this, for owing to the mixing, the two characters of high yield (in dough, or bread), which distinguishes hard wheats, and of large volume of bread proper to the soft wheats, produce a type of loaf excellent as regards size, structure and flavour.

From a mixture of *Tr. durum* v. *melanopus* with *Tr. vulgare* var. *albidum* No. 721, or *Tr. vulgare* var. *hordeiforme* we get:

Yield in dough	152
" " bread	134
Volume	226

Tr. durum v. *hordeiforme* and *Tr. persicum* mixed with local, soft, winter wheat produce :

Yield in dough	157
" " bread	140
Volume	450

Bread made from hard grain has small, thin-walled cavities, whereas that made from soft grain is coarser in structure, the cavities being larger and more irregular. Some varieties related to the hard types, such as *albidum* No. 604, *Tr. persicum*, *Tr. dicoccum*, and the hybrid *graecum* × *lutescens*, are somewhat coarse although their cavities are small.

The elasticity of the dough and the form of the loaf differ greatly in the several varieties. Loaves made from hard wheat keep their shape well, whereas those made from soft wheat lose it; *Tr. dicoccum* is one of the worst wheats in this respect, the loaves made from it being flat and malformed with a hard coarse, cracked crust.

Hard wheats also rank first as regards taste. The varieties of *Triticum durum* cultivated in South-East Russia are therefore excellent both for milling and bread-making. The soft autumn wheats give a white flour which makes a bulky, but shapeless loaf and so should always be mixed with hard wheats.

G. A.

769. Direct Bread-Making.

BERNARD, L. (Directeur des Services agricoles du Loiret), *Journal d'Agriculture Pratique*, La panification directe, Year 87, No. 22, pp. 438-440, fig 1 Paris, 1923.

In this method, the wheat is made first into dough and subsequently into bread without any preliminary milling. It is, however, put to soak for about 12 hours in a vat containing water and a little alcoholic yeast during which process it takes up as much as 70 % of its weight of water. The gluten present in the endosperm of the grain swells, and the glume bursts and becomes detached. The grain then passes into an apparatus where it is crushed by the pressure of a rotating perforated cylinder lined with fine metal network. The doughy paste passes through the walls of the cylinder and collects inside, while the bran is kept back by the netting through which it cannot pass. The dough is then salted and yeast added.

In this manner, all the farinaceous matter is retained, hence the average yield is 85 % of flour. The bread thus made is darker than the ordinary product, but richer in assimilable substances, as has been shown by a communication made to the Académie de Médecine by MM. LEPRINCE and LECOQ.

R. D.

770. Extraction of Palm Oil by means of Solvents.

STIELTJES, A (Directeur des Services Techniques de l'Institut Colonial de Marseilles). Essai de traitement des fruits d'*Elaeis* par dissolvant. *Bulletin des Matières Grasses*, No. 7, pp. 253-255. Marseilles, 1923.

To obtain the maximum percentage of oil, the common practice of depericarping and pressing, is in many ways inconsistent. The possibil-

ities of extraction by means of solvents is under consideration and the method has been tested at the Institut Colonial de Marseilles. Fruits from the Ivory Coast were treated with ethylene trichloride as a solvent, after the pulp had been carefully crushed in a stone mill.

The percentage of oil in the pulp was determined as 46 % and the oil extract as 44.5 %; the oil obtained possessed a good red colour, moisture content only 0.5 %, acid content 14.6 % (oleic).

Results obtained show the practicability of the solvent method of extraction without depulping, also, the non-deleterious effect of the solvent employed and the simplicity of the process. Disintegration may be effected after the oil is extracted.

Further tests will be made with fresh fruits and comparison made between the use of mill pulp crushers and the large, metal, double-walled and steam-heated presses in general use in the Far East. M. L. Y.

771. Tartaric Acid Industry in Spain.

BELLVER MUSTRIELES, V. Las industrias tartáricas en España. *Boletín de la Dirección General de Comercio, Industria y Minas*, Year XI, No. 33, pp. 7-9. Madrid, 1922.

According to the reports received from the "Junta Consultiva agronómica" in Spain, about 2300 metric tons of wine lees are obtained each year, containing an average of 6000 t. of tartaric acid and in addition 5800 t. of tartar containing 20 to 30 % acid tartrate of potassium and 40 to 50 % calcium tartrate. Other sources of tartaric acid are mentioned such as grape residue, grape stalk and the liquid excretion which contains from 1 to 1.5 % tartaric acid. The amount produced is continually on the increase, although not yet equal to the estimated average in France and Italy. The industry has so far not been much developed in Spain; from 1910-14 the average annual export = 11 300 t. crude tartrate and from wine lees 697 t. of calcium tartrate, and in the following 5 year-period, 6890 and 800 t. respectively; average importation above 200 t. tartaric acid.

The author refers to the pre-war world production of tartaric acid as being over 12 000 t., of which 2500 t. was produced in Great Britain, as much again in the United States, 1300 t. in France, 1000 in Austria-Hungary, 3000 t. in Italy, 600 t. in Russia, 350 t. in Argentina (which imports 465 t.) Germany exported 1900 t. of tartaric acid and 1000 t. of tartar emetic (mordant for coating cotton materials). J. P. C.

772. Retting of Sisal Hemp.

TRABUT, L. Extraction des fibres du Sisal par macération. *Bulletin Agricole de l'Algérie-Tunisie Maroc*, Year 29, No. 6, p. 109. Algiers, 1923.

The difficulty of obtaining an inexpensive and effective de-fibring machine has hitherto hindered the exploitation of sisal fibre, to any great extent, in Algeria. Dr. BRUNOT has solved the problem of the extraction of the fibre by means of retting by microbiological action.

Leaves can be collected at any season of the year and should be passed through a roller (the liquid may be utilised for the production of alcohol) and then placed vertically in ferro-concrete vats containing a culture of *Bacillus felsineus* (1) at a temperature of 37° C. The retting is effected in 3 ½ days, after which the fibre may be washed and dried. This method is inexpensive and four vats are sufficient although a considerable quantity of water is required it is more economical than the ordinary de-fibring machines which are only practicable on a large scale. The retted fibre is of fine quality, the waste is negligible and the alcohol by-product is worth attention.

R. D.

773. The Melaleuca Cork Industry.

MOREL, J. B. L'industrie du liège de Melaleuca *Recherches et inventions*. Year 4, No 47, pp 211-216 Paris, 1923

The bark of *Melaleuca leucadendron* supplies a new insulating material that meets the demands of industry for the satisfactory utilisation of cold and heat. The species belongs to the Fam. Myrtaceae, distributed in Guiana, Oceania, Indo-China and in Southern China, where it is commonly known as "niaouli", "tram", "trame". Regular production is assured with the numerous plantations (many several miles square) and by the quick re-growth (5 to 6 years). The trees reach a height from 10 to 26 ft. in the forest and still higher when isolated. By distillation the "cajeput" oil has been obtained from the leaves, used by the chemist (Goménol).

The tree is suitable for stripping like the cork oak. The first bark has proved serviceable, thickness 1 to 1.5 cm although the second and succeeding strippings give better quality bark, which forms a series of thin flakey layers (10 per mm), stuck together by the resin and calcium oxalate. The flakes are easily separated. The natives use this bark for making cases, pipes etc. The cork layer is 25 % lighter in weight than that of the ordinary cork tree ($D = 0.18$ to 0.20), is more readily cleaned without splitting, less hygroscopic and more impermeable. It is not liable to decay and rot. From every point of view it has distinct advantages. The calorific conductivity is 0.0359.

A detailed description is given concerning the various trials made. The Government of Indo-China has taken up the matter; the plantations have already been enclosed and investigations are in hand relative to the utilisation of the bark without damage to the tree.

R. D.

774. Paper from Australian Timber.

Agricultural Gazette of New South Wales, Vol. XXXIV, Part I, p. 57, Sydney, 1923.

The Director of the Commonwealth Institute of Science and Industry reports that it has been demonstrated for the first time in Australia that

(1) *Bacillus felsineus*, isolated by CARBONE has been successfully applied to the retting of several fibres, including sisal and other *Agave* spp See R. 1917. No. 956; R. 1918. N 692 (Ed)

good quality paper can be made from the wood of Australian trees. Experiments on a semi-commercial scale are being carried out to follow up laboratory results, in order to investigate the paper-making qualities of the pulps and to ascertain the commercial possibilities. Successful trials have already been made with pulp consisting of 60 % soda pulp from Victorian timbers — mountain ash (*Eucalyptus regnans*), "silvertop" (*E. sieberiana*) and "Wollytritt" (*E. delegatensis*) and of 40 % imported sulphite pulp. M. L. Y.

Animal Products.

775. The Höyberg Process for Determining the Fat Content of Milk and Cream.

JENSEN (Professor of the Polytechnic School at Copenhagen) Le procédé Hoyberg pour la détermination de la matière grasse dans le lait et la crème *Le Lait*, Year 3, pp 177-187, tables 8. Lyons, 1923.

The HÖYBERG process for the determination of the fat content of milk and cream is a simplification of the GERBER method, in so far that it allows of the separation of the fat present in the milk without the use of centrifugal force. It is more rapid than other methods. The albuminoid substances are dissolved by means of an alkaline solution (solution I), while various lower amyl alcohols are employed to break up the emulsion.

The system has, however, the following disadvantages: the small variations in the amount of solution II are sufficient to influence perceptibly the results of the analysis; it is very inferior to the GERBER method if used for the analysis of the milk of cows that are at the end of their lactation period. For this reason, the HÖYBERG process was improved by replacing solution II by a mixture of several kinds of alcohol.

The new method has been tested by the author who has arrived at the following conclusions: within the limit of practical variations, the new solution II has no marked effect on the first decimal place of the amount of fat found. Although the new solution did not cause any essential difference in the estimate of the fat content of cows' milk at the end of the lactation period, yet since this milk should fetch a lower price owing to its slightly lower fat content, the HÖYBERG process is more useful than the GERBER method which gives rather too high a fat return.

In order to test the value of the HÖYBERG method when applied to the milk of cows that have not reached the end of their lactation, the author examined the milk of 60 cows that had not passed the eighth month of their lactation period.

The fat content was determined by the RÖSE GOTTLIEB process, the results being compared with those obtained by the GERBER and the HÖYBERG systems.

If the results from the first method are regarded as correct, the figure obtained by the HÖYBERG process are a little more exact than those returned by the GERBER system when it is a question of the milk of different cows.

In cream analysis, the new method is slightly modified, 5.5 cc. of solution I and 1 cc. of solution II being employed for 4.65 cc. of cream.

The examination of 13 samples proved this HÖYBERG method to be very much superior to the GERBER method for the determination of the fat present in cream. Both of these methods give higher figures than the RÖSE GÖTTLIEB process, but whereas the deviation is 0.4 % in the case of the GERBER method, it is only 0.2 % in that of the HÖYBERG method.

It should also be noted that this method does away with the use of amyl alcohol, and allows of accurate determinations of the fat content of milk, or cream being obtained in the kitchen, or in the dairy.

F. S.

776 The Solubility of Copper in Milk.

RICE, F. E., and MISCALL, J (Department of Chemistry, Cornell University, Ithaca, New York) Copper in Dairy Products and its Solution in Milk under Various Conditions *Journal of Dairy Science*, Vol VI, No 4, pp. 261-277, bibliography. Baltimore, 1923 (1)

Since it was evident from the work of other investigators that copper is present in cows' milk, the authors decided in view of the importance of the subject both from the industrial and the commercial standpoint, to carry out investigations with the object of discovering to what extent milk can act as a solvent of copper.

Usually they employed a strip of pure copper which was left in contact with the milk in a glass vessel. Subsequently, the milk was evaporated to dryness and the residue was burnt, the ashes being recovered with a small quantity of nitric acid. The copper that had passed into solution was estimated electrolytically, or in some cases, by means of the ethyl-xantho-potassic method.

The solvent action of milk upon copper is not affected by carbon dioxide, but it is enormously increased by the presence of air and of oxygen. Thus, it is advisable to use closed copper utensils, as far as possible, in dairy work, or better still, to use vessels made of some metal other than copper. The solvent capacity of milk is also increased not only by the amount the surface in contact with the metal, but also by the presence of a film of oxide overlaying the copper, this shows the importance of keeping dairy utensils scrupulously clean and of not disinfecting them with chlorine compounds, as the liberation of chlorine may corrode the surface of the copper.

As regards temperature, the authors discovered that copper is least easily attacked by milk when it is at the boiling-point. Hence, a good practical rule is to bring the milk to the boil as quickly as possible; this treatment is to be recommended, as boiling appears to destroy, or transform the factor upon which the solvent action of the milk depends. This action would appear not to be increased by the addition of sugar (to the amount of some 18 % which is the quantity generally introduced into

(1) See R. 1923, No 1 p. 225. (Ed.)

condensed and sweetened milk), or by the milk being rendered slightly acid. The authors found in other experiments, that the copper is distributed in the cream and whey respectively in proportion to their water-content which seems to show that the metal is chiefly dissolved by the water

In conclusion, theoretical and experimental considerations appear to warrant the opinion that the copper in solution in the milk is displaced by tin whenever it comes into contact with this metal, so that less copper finally remains in solution when the milk is in contact at the same time with surfaces of copper and of tin. In the electro-chemical series of the elements, copper comes a little below tin, consequently, tin would take the place of copper in a solution. This fact makes it possible that after a certain time, the amount of copper found in condensed, or evaporated milk kept in iron receptacles lined with tin may actually be less than the quantity present at the time the product was made in unlined copper utensils. The experiments of the authors have proved this to be the case

G Tg.

777 The Envelopes of Foam Bubbles in Milk.

HEKMA, E, and BROUWER, E., Over melkschuimvleszies en de aan hunne vorming ten grondslag liggende substantie. *Verslag van landbouwkundige onderzoekingen der Rijkslandbouwproefstations*, No XXVIII, pp 46-59, plate 1. The Hague, 1923

Curious round corpuscles with double outline and much resembling red blood corpuscles are found in centrifuged milk sometimes to the number of 2 000 000 per cc. The author does not, however, consider them to be blood corpuscles, but regards them as envelopes. These cases are 10-25 microns in size and have a wall which is distinctly visible and encloses a certain amount of liquid, but which cannot always be distinguished. Sometimes, especially when the corpuscles are large, the wall is very thin and folded, so that the original shape is not recognisable.

These corpuscles are also found in normal milk, but they seldom occur in great quantities, they attain a somewhat larger size (20-50 microns), in untreated milk than in the centrifuged product.

Experience has shown that these bodies are always present when milk becomes frothy. Colloidal substances collect on the surface of the foam bubbles forming a gel. Later, the gas escapes from the bubbles and dissolves in the fluid, as can be clearly seen under the microscope. The walls, however, generally remain, though it is certain that some of the largest bubbles burst and allow the gas to escape.

These envelopes are formed during the centrifuging process, and in untreated milk they arise from the froth that collects while the cow is being milked. The author's experiments show that milk is subject to alteration even while it is in the milking pail.

According to TROMMSDORF, these foam bubbles constitute a source of error in sedimentation experiments. Even centrifuged milk does not consist solely of milk minus the fat globules.

The author further suggests that these envelopes perhaps form the substance which, in the opinion of RAHU, plays one of the principal parts in butter production. The sediment resulting from the repeated centrifuging of milk chiefly consists of the envelopes of the froth bubbles.

D. v. S.

778. The Localisation of Rennet in "Vells".

HEKMA, E., and BROUWER, E. Over de localisatie van het lebcenzym in gedroogde lebmagen. *Verslag van landbouwkundige onderzoekingen der Rijkslandbouwproefstations*, No. XXVIII, pp. 78-86, fig. 1. The Hague, 1923.

The author ascertained the amount of rennet obtained from various "vells" made from different parts of the abomasum (the manyplies etc. and also from the parts adjacent to the pylorus). The vells were cut up and extracted, most of them being brought to a certain degree of acidity (pH 5.2-4.9) by means of an electrode of the BARENDRECHT type: the temperature was raised to 35°C., that being the temperature at which the ferment becomes active.

The total amount of rennet obtained from the different parts was variable.

The total quantity of rennet yielded by the manyplies was considerable (about 19 %), but neither the number nor weight of the manyplies must be taken as an index of the quantity of rennet obtainable from a vell for other parts should also be considered especially when calves' stomachs' are scarce. A good deal (average 5.1 %) of extracted rennet can be obtained from the parts near the pylorus and as this extract is more easily filtered than the extracts of the other portions of the abomasum, the pyloric tract should not be rejected.

D. v. S.

779. The Proper Preparation and Conservation of Rennet.

HOLWERDA, B. J. Over rationeele stremselbereiding en stremselbewaring. *Verslag van Landbouwkundige onderzoekingen der Rijkslandbouwproefstations*, No. XXVIII, pp. 60-77, diagram 1, tables 12. The Hague, 1923.

The author reports that solutions of rennet which show no alkaline reaction and are free from mould often appear to have deteriorated, and mentions several instances in support of this statement. The following question has been asked the Dairy Station of Hoorn (Holland):—

"What can be the reason for the deterioration of rennet kept under normal conditions?"

Rennet solutions obtained by extraction from the dried rennet-stomachs of calves (vells), often show during the preparation process an increase in their coagulating action which continues for a certain time. This is to be attributed to the fact that part of the enzyme is still in a latent condition, like a pro-ferment, and must be activated before it can produce coagulation. This period of increased coagulation may be considerably shortened by heating to 37° C or else by extraction with slightly acid liquids.

The author's investigations had for the object the task of determination of :—

- 1) The amount of acid that may be added to an extract containing a pro-ferment without injuring the enzyme by excess acidity.
- 2) The effect of the degree of acidity upon the speed with which the pro-ferment is transformed into a ferment.
- 3) The effect exerted upon the stability of the rennet solution (if kept 2 or 3 months) by the degree of acidity required to activate the pro-ferment.

Solutions of ferments were used that were as nearly as possible the same as those employed in cheese-manufacture, and contained 10 % sodium chloride, boracic acid in some cases being added as a preservative. It was found that the transformation of the pro-ferment took place without any injurious effect and at the right speed, only within a certain range of acidity (pH 4.7-5.0 at 25° C, and pH 5.1-5.3 at 37° C), no matter what kind of acid is used. The electrometric measures of pH are, however, subject to error caused by the sodium chloride, therefore the figures obtained cannot be regarded as absolute. The degree of acidity necessary for activation is injurious to the ferment after a time, hence the author advises that the acidity of such solutions should be kept within pH 5.3 and 6.3.

In practical work, the actual acidity must be determined with methylene red. The author gives a method for obtaining in a few days, perfectly active and quite stable solutions of rennet. He found that several of the commercial extracts of rennet contain more or less large amounts of acid which proves them to have been improperly made. Extraction for longer than 24 hours is not necessary. The author describes, in conclusion, a method of estimating the quality of commercial vells

D v S

780 **The Production of Volatile Fatty Acids and Carbon Dioxide by Propionic Acid Bacteria with Special Reference to their Action on Cheese.**

SHAW, R. H., and SHERMANN, J. M. (Research Laboratory of the Dairy Division, United States Department of Agriculture, Washington D. C.) *Journal of Dairy Science*, Vol. VI, No. 4, pp. 303-309, bibliography. Baltimore, 1923.

In connection with the ripening of Swiss cheese, two very important problems are presented, viz, what are the respective sources of the carbon dioxide producing the so-called eyes and of the volatile fatty acids which play so large a part in determining the aroma and flavour of the Emmental type of cheese?

SHERMANN had already designated his special propionic acid bacterium, which he states is different from the form studied by FREUDENREICH and JENSEN in Europe, as the agent transforming the lactose and lactic acid of Swiss cheese into acetic acid, propionic acid and carbon dioxide.

The authors repeated the experiments that had previously been made

and allowed this bacterium to act upon a 1 % solution of peptone to which were respectively added milk-sugar, glycerol, and butter-fat, or else the calcium salts of either lactic, succinic, formic, acetic, propionic, n-butyric, or iso-butyric acid. The volatile fatty acids were determined by the DUCLAUX method, and when the action of the micro-organism on the medium proved positive, the authors made quantitative and qualitative tests on solutions of the same composition. The carbon dioxide was determined by absorbing it with barium hydroxide, the apparatus specially designed for the purpose by ELDREDGE and ROGERS being employed.

There is no need to dwell further on either the lactic acid, or the lactose fermentation, since the one is well-known, and the other is probably of little account as it occurs previous to the eye-formation in the cheese, and in the early stages of the aroma, but the fermentation of the succinic acid, on the other hand, is of paramount importance. If, as has been proved by the work of JENSEN and SUZUKI and of HASTINGS and HART, this volatile acid is chiefly derived from the fermentation of lactose, this would seem to point to the presence of succinates from the beginning of the action of the propionic bacterium. As regards the fat, since the propionic bacterium produces the fermentation of the glycerol with the formation of acetic and propionic acids, it is possible that these acids are actually the result of the glycerol fermentation of some portion of the fat, probably the part that has been hydrolised. Therefore, if the decomposition of the fat by means of the above micro-organism were definitely proved, it is obvious that its importance in the ripening of the cheese would also be known. A slight and limited degree of decomposition of the fat would have a great effect upon the flavour of Emmental cheese, and would probably be the cause of the characteristic whitish colour assumed by it during the ripening process. On the other hand, in the course of their experiments, the authors met with no fermentation of the formic, acetic, propionic, normal butyric, or iso-butyric, acids, therefore since volatile fatty acids and carbon dioxide were produced when the propionic acid bacteria acted on peptone alone, the nitrogenous compounds of the forage may well be the source of both these substances

G. Tg.

781. The Control of Insects that Attack Vells.

HEKMA, E., and BROUWER, E., Over de bestrijding van insecten die de gedroogde lebmagen canvreten. *Verslag van landbouwkundige onderzoekingen der Rijkslanbouwproefstations*, No. XXVIII, pp 87-99. The Hague, 1923.

Several species of beetle (*Necrobia ruficollis*, *Dermestes lardarius*), eat and damage vells.

Hitherto, no effective method of destroying these beetles without harming the ferment has been discovered, but the author shows in his work that chloroform vapour kills the insects and does not injure the ferment, and he explains the application of this remedy.

After some time, the vells lose all smell of chloroform, and the author is convinced from the results of his experiments that cheese prepared with

rennet from chloroformed vells is as good as that made with ordinary rennet.

D. v. S.

782. Cleaning Apparatus used in Machine Milking.

BURGWALD H. (Assistant Market Milk Specialist). Cleaning Milking Machines. *U. S. Department of Agriculture, Farmers' Bulletin*, No. 1315, pp 15, figs. 13. Washington. D. C., 1923.

The Department of Agriculture of the United States has instituted a series of experiments in the sterilisation of apparatus used in machine milking. Heat is the safest and simplest means of sterilisation, the effect of which has chiefly been studied with reference to apparatus working in a vacuum, but the same principle could be applied with some small differences to other types.

The comparative bacterial counts made in the case of apparatus sterilised with a solution of chloride of lime and with heat respectively have been favourable to the latter method. The average number of bacteria per cc. found in milk samples taken at 13 farms where other methods were employed was 257 900, whereas in the case of farms where sterilisation by heat was practised, the average number of bacteria present was only 19 300 per cc. (the average age of the samples at the time the count was made was 12 hours).

The rubber portions of the apparatus were but little, if at all, more affected by the temperatures employed (71°C to 72°C.) than when recourse was had to other methods of sterilisation. The rubber must however be cleaned carefully before the heat is applied, for fatty substances exert an injurious effect at these temperatures.

The various operations of the process are explained by a series of diagrams. Immediately after milking, the apparatus is rinsed in hot water (which is in all cases sucked up by a vacuum system), 10 to 12 times in succession. It is then rinsed with water in which some cleansing substance has been dissolved, rinsed again, and subsequently immersed in water raised by steam to 71°-72° C. and kept at this temperature for 15-30 minutes. If no steam for heating is at disposal, it is best not to immerse the rubber portions until the heating is finished, in order to prevent their coming in contact with the wall of the heated receptacle. The vacuum tube ought to be cleaned every fortnight by the passage of hot water. The pails and covers should be sterilised with steam by preference, or else by means of immersion for 5 minutes in boiling water.

R. D.

783. Cleaning Aluminium Dairy Utensils.

DROUILLY E (Directeur du département d'Aluminium à la Société des Tréfileries et Laminoire du Havre). Le nettoyage des ustensiles de laiterie en aluminium. *Le Lait*, Year 3, No 2, pp. 157-159. Lyons, 1923.

In order to give aluminium pans a new appearance, it is only necessary to proceed as follows: immerse them for some seconds in a bath of 10 % boiling caustic soda, wash them in running water and put them for

5 minutes in a cold 10 % aqueous solution of nitric acid, wash them over with a soft rag in order to remove the sodium nitrate that has formed, wash them again to remove any nitric acid present and then dry the pans. The drying method most commonly adopted is to dip the pans into boiling water and leave them to drain. This process must, however, only be carried out at long intervals in dairies, for it has the disadvantage of reducing the thickness of the metal about $\frac{1}{100}$ of a mm. for every minute of immersion in the bath of 10 % caustic soda heated to 100° C.

As a rule, cold carbonate of soda which has hardly any effect upon aluminium is employed in dairies, but fairly warm solutions are to be recommended for detaching the particles of dried milk and the fatty matter. As this solution may attack the aluminium in the course of time, sodium silicate to the amount of 25 % of the weight of the sodium carbonate should be added to a bath of sodium carbonate of the temperature of 75° C.; if the temperature of the bath is 100° C., the amount of silicate may be a little increased, whereas if it is only 30° C, it suffices to add a weight of sodium silicate equal to 10 % of the weight of the sodium carbonate.

F. S.

Preservation and Packing.

784. Conservation of Forages (Dried Grass Silage) in Switzerland.

WIEGNER, G., CRASSEMANN, E., and MAGASANIK, J., Communicated by WIEGNER, G. Untersuchungen über Futterkonservierung I. Das sogenannte Süssgrünfutter (Mitteilungen aus den Agr.-chem. Laboratorium der Eidg. Technischen Hochschule, Zurich). *Die landwirtschaftlichen Versuchs-Stationen*, Vol. C, Parts III-IV, pp. 143-268. Berlin, 1923

The authors pass in review the results hitherto obtained at the Swiss Agricultural Experiment Stations with the various methods of conserving forages, and especially silage, made according to the different processes (W. VÖLTZE: impermeable silo, low temperature, total exclusion of air, lactic fermentation M. POPP and R. FLOESS: filling a perfectly air-tight silo with wilted compressed grass, conservation in silos of the German type; North American process, etc.); an account is then given of their own work.

The work carried out at the Swiss Agricultural Experiment Stations (A. BURRI, P. LIECHTI, and A. SCHMID) has proved that as regards the production of crude nutritive substances, wilted grass silage (sweet silage) is much superior to hay even in good hay years, but feeding cows on this silage is detrimental to the quality of Emmental cheese.

In table I are summarised the data of 21 analyses of Swiss sweet silage made by various authors between 1917 and 1921.

The authors, after discussing these data, reach the following conclusions; Given the same conditions:—

1) The percentage of free volatile acids in fresh sweet silage and in its dry matter rises with the increase in the amount of water present in the conserved forage.

TABLE I. — *Averages of 2 analyses of Swiss sweet silage.*

	Dry Grass			Fresh Grass		
	Average	Maximum	Minimum	Average	Maximum	Minimum
	%	%	%	%	%	%
Water	—	—	—	67.28	79.89	41.36
Crude protein	14.70	23.45	10.25	4.88	11.24	2.39
Pure protein	9.80	16.03	4.17	3.33	8.17	0.89
Crude fat	7.26	15.49	1.04	2.34	4.40	0.24
N-free extracts	32.50	46.72	24.44	10.70	17.13	5.28
Crude fibre	29.87	37.01	18.90	9.78	13.10	4.35
Crude ash	11.04	16.14	7.03	3.59	6.94	2.02
Digestible crude fibre	9.11	16.85	2.35	3.04	6.26	0.81
Digestible pure protein	4.34	10.79	0.22	1.53	4.38	0.05
Free lactic acid	2.98	8.01	0.00	(1) 0.97	1.99	0.00
Free volatile acids	1.65	4.24	0.00	0.46	1.15	0.00
Total free acids	4.63	10.60	1.58	1.43	2.13	0.68
Crude protein in % of pure protein	66.67	94.18	26.65	—	—	—
Digestibility coefficient of the crude protein	60.65	86.24	20.42	—	—	—
Digestibility coefficient of the pure protein	41.50	85.05	5.28	—	—	—

(1) In 37 samples of dry matter, the average, maximum and minimum found were respectively: lactic acid 0.86—1.99—0.00 %, volatile acids expressed as acetic acid 0.43—1.46—0.00 %. In one third of the samples, butyric acid was found up to a maximum of 0.27 %.

2) The percentage of non-volatile free acids in fresh sweet silage, and probably also in its dry matter, increases with the decrease of the water present within certain limits, and under similar conditions.

3) The higher the crude fibre content of fresh sweet silage, the lower is its percentage of amido-acids and the digestibility of the crude protein.

4) There are some indications that as the water content of the silage decreases, the percentage of free volatile acid in the dry matter also diminishes. It would further appear that the percentage of free volatile acids increases proportionally with that of the crude fibre.

Grass containing a low percentage of crude fibre, and well-dried before being put into an air-tight silo, produces a silage which is not too acid and contains the lowest possible amount of free volatile acids, thus fulfilling the chief requirements.

The authors' experiments were carried out with two objects :

1) To study the conservation of tightly-packed silage in a hermetically closed silo.

2) To study the conservation of loosely packed silage in an imperfectly closed silo.

In both cases, they examined the grass as soon as it left the silo, in order to determine the chemical changes it had undergone both while still hot, and after it had cooled. The following is a summary of the data obtained :

1) With a rapid rise of temperature from 20° to 45-50° C in the grass which was loosely packed, and thus in close contact with the air, the silage (whether made in the Herba type of silo, or in the two smaller silos used in the experiment) contained no appreciable quantities of free acids, or of non-volatile free acids

It appears that, under normal conditions, the rapid heating of wilted grass is due to plant respiration ; whether it also depends to some extent upon the action of micro-organisms was not investigated.

2) The percentage composition of the dry matter of fermented forage shows a decrease in the N-free extracts as compared with that of the dried grass

3) On the application of great pressure which rapidly expelled the air from the heated grass and made it cool down quickly, the decomposition of the albuminoid substances in the dry matter and their decrease in digestibility were less than those shown by the analyses of the heated grass. No attempt was made to discover whether these modifications are caused by the heating, but in any case, they were too slight after the grass had cooled to be determined by any of the methods used

4) A less amount of compression and the incomplete exclusion of the air have the effect of making the cooling process longer. A comparison of the composition of grass thus treated and that of heated grass silage shows that a little less lactic acid and a little more acetic acid are formed than when the silage is well compressed. A decrease in the percentage of carbohydrates was also shown

Further, with little pressure and imperfect exclusion of the air, more of the albumin is decomposed and the ingestibility of the albuminoids is less than in the case of the heated grass.

These experiments have shown that as a result of pressure, the sap of the forage passes downwards. The thermic effect of the acid formation is very slight, and in any case, insufficient to cause the heating of the mass of forage. The specific heat of the dry matter in a normal silage ranges from 0.3-0.4

The authors compared the amount of nutritive substances obtained in one year per hectare of grass made respectively into silage and hay. The digestibility experiments were made on lambs.

With 3 cuts, the yield per hectare, not counting the last cut is :

14 357.8 kg. good sweet silage ready for use and containing 58.83 % water, viz. 59 235 kg. of dry matter, or 7672.3 kg. of excellent hay containing 10.33 % water viz 6879.8 kg. dry matter.

The digestibility percentage coefficients in the case of silage and hay are respectively : dry matter 69.80 and 65.91 ; organic matter including free acids 72.25 and 67.90 ; crude protein 63.79 and 62.60 ; pure protein 45.43 and 55.89, crude fat 68.99 and 53.39 ; N-free extracts including free acids, 75.38 and 71.79 ; crude fibre 72.92 and 65.63 ; crude ash 47.64 and 47.87. Thus the dry matter, organic substances, ether extract, crude fibre and N-free extract were digested better in the case of the hay, while the protein was not digested so well.

The calorimetric determinations agreed very well with the number

of calories obtained from the analysis of the total and the digestible constituents.

As compared with hay, silage has no particular action upon the secretion of nitrogenous digestive juices. The metabolism experiments with nitrogen proved that lambs aged 1 to 2 years assimilate about equal percentages of the pure protein they obtain from silage and hay, but they assimilate a lower percentage of the crude protein from silage than from hay, as the crude protein of hay contains less non-albuminoid nitrogenous substances.

The calculation of the starch value on the basis of the crude protein and corrected by the pepsine and trypsin soluble substances present in the excrement gave 68.8 for the dry matter of the silage and 49.2 for that of the hay. With KELLNER'S method, the calculation being based on the pure protein, the figures obtained were respectively 52.7 and 44.1, or on applying the corrections for the pepsine- and trypsin-soluble substances present in the excrement, 54.9 and 45.9 respectively. The milk value calculated by the NILS-HANSSON system gave respectively 57.0 and 47.1. These various methods of calculation agree fairly well in showing that, as regards the starch value, 1 kg. of the dry matter of hay can be replaced by 0.829 kg. of the dry matter of the silage; this has been proved by numerous practical experiments.

Taking at 100 the crude nutritive substances, digestible nutritive substances and starch units contained in the hay crop obtained per hectare at Liebefeld in 1921, 2 or 3 cuts would give *when made into hay* (hay with 10.33 % water, 49.54 % of starch units according to KELLNER and 5.40 % of pure digestible albumin: 76.723 qx of starch units, of which 4.14 qx consist of pure digestible albumin, *when made into silage* (a product with 58.83 % water, 21.70 % starch units and 2.01 % pure digestible albumin): 143.878 qx per hectare of silage with 31.22 qx of starch units, of which 2.89 qx. are of pure digestible albumin. Further, the forage to be made into silage was cut 2 or 3 weeks sooner than the hay, as is customary, therefore the 4th cut was heavier than in the first case (59.85 quintals per hectare of fresh grass as against 37.8).

Hence by making the grass into silage the starch value per unit of surface is at least equal to that obtained when it is made into hay, so that in good hay seasons it is best to make hay, but in bad seasons, it is advisable to put the grass into the silo.

In the experiments conducted in 1921 at the Higher Technical School at Zurich, a comparison was made between grass (taken as = 100) sweet silage and "Elektrofutter" (hay made in a desiccator heated by a continuous electric current of 110 volts). The results are given in Table II (digestive tests made on lambs).

In order to compare these data with the above-mentioned data obtained at Liebefeld, it is only necessary to make up to 100 the figures relating to the hay, in which case those referring to the sweet silage become: 85.8 for the digestible organic matter, 51.4 for the pure digestible protein and 99.2 for the starch units. Thus, also in the Zurich experiments in good hay seasons, the same number of starch units per hectare is obtained

by putting the dry grass into the silo as by making it into hay. The coefficients of digestibility obtained in these experiments with a lamb are given in Table III.

TABLE II — Yield per hectare

	Grass	Hay	Sweet silage	Elektrofutter
Digestible organic matter	100	79.4	68.1	67.2
Pure digestible protein (without correction)	100	59.7	30.7	28.6
Starch units calculated from pure protein (without correction)	100	59.2	58.7	54.8

TABLE III. — Digestibility coefficients of grass, hay, sweet silage and "Elektrofutter"

	Organic matter	Crude protein	Pure protein	Crude fat	Crude fibre	N. free extract
Grass	60.0	71.6	69.8	53.6	58.2	71.3
Hay	60.9	64.6	58.2	54.2	57.3	63.4
Sweet silage	56.6	51.5	37.7	56.7	59.0	60.2
Elektrofutter	55.1	46.2	32.0	31.6	52.2	64.8

F D

785 Apparatus for Drying Hay without Sunshine.

The Royal Show at Newcastle *The Engineer*, Vol CXXXVI, No 3523, pp 17-20 London, 1923

Mr. R B MATTHEWS M. I. E E exhibits an apparatus which he claims will render agriculturists independent of sunshine for drying their hay. The hay is made up into a conical heap and dried by means of a strong current of air directed from the base to the top by means of a ventilator. This treatment is discontinued after some hours, and as the heat increases, bacterial and chemical action begin. The bottom of the cock first commences to heat up and reaches a sufficient temperature after 24 hours. The aeration is repeated and is succeeded by an interval of repose during which a new layer of hay attains the degree of heat required. This process is repeated until the whole heap has been acted upon in the same manner. The inventor states that hay thus made is superior in quality to the ordinary product, and that in spite of the expense of transporting a large amount of fresh grass, the net cost is lower, because the usual operations of hay-making are not required.

R. D.

[785]

786. Preservation of Sugar Cane in Closed Vessels.

AUFFAY (Chef du Laboratoire de Chimie Agricole de la Direction des Services Economiques de l'Indo-Chine) Essais de conservation de canne à sucre en bocal fermé *Bulletin économique de l'Indo-Chine*, Year XXV, No 157, pp 725-727. Hanoi-Haiphong, 1922

Experiments were made to discover an antiseptic suitable for the preservation of sugar cane and which would conserve their original colour, this being one of the distinctive characteristics of the varieties.

Twenty-two different solutions were tested. The three giving the most satisfactory results were

- 1) Salicylic acid 2 gm., 95 % alcohol, 100 cub. m.; water, 900 c.c.
- 2) Bichloride of mercury, 2 gm.; 95 % alcohol 100 cub m, water 900 c.c.
- 3) Acetone 100 c.c., water 900 c.c

The colour of the cane is slightly more vivid after steeping particularly with acetone, but the special characteristics are maintained and the general appearance is better than when the other solutions are used.

(Correspon Indo-China)

787. The Preservation and Packing of Rubber Latex for Shipment.

EATON B T (Agricultural Chemist) Department of Agriculture F M S , and S S in *Malayan Agricultural Journal*, Vol X, No 6 pp 151-154 Kuala Lumpur. 1922

The author draws attention to the requirement for a satisfactory method for the preservation of latex for shipment and refers to several substances which have been used as preservatives, amongst which ammonia is at present, the most suitable Sodium hydroxide and carbonate can be used, and potassium cyanide is a good preservative, but somewhat dangerous to use Boric acid is useless Sodium phenate may prove to be suitable if the free alkali is subsequently neutralised, and soluble fluorides should be tried Ammonia is treated in detail and with a warning as to the care that is necessary in handling this solution in a tropical climate and instructions are given for its employment in the three following forms —

- (a) as Liquor Ammon fortis, the solution of commerce ,
- (b) as a compressed gas contained in cylinders ,
- (c) when generated from salts of ammonia

Suggestions are also made with reference to methods of packing of the latex for shipment

W S. G.

788. Packing of Tomatoes for Market.

I — PARSONS, F E Preparation of Fresh Tomatoes for Market U S. Department of Agriculture, *Farmer's Bulletin* No 1291, pp. 3-32, figs. 20. Washington, D C, 1922.

II. Packing of Tomatoes for Export. *The Farmer's Weekly*, Vol. XXV, No. 650, p. 2323. Bloemfontein, 1933.

There has been a serious lack of uniformity in the methods employed for packing fresh tomatoes for market and export. PARSONS has inspected the important production centres in the United States, and describes methods that have proved successful in commercial undertakings and others which have resulted in loss. As regards the suitability of certain packing materials, the Chief of the Division of Horticulture, in South Africa confirms the recommendations put forward in Germany and Holland with respect to the value of peat-mull. Ripe tomatoes packed in peat-mull retain their colour and hard skins as well as their juice and flavour. Evaporation is lessened and the weight of the fruit remains almost unchanged.

With the rise in temperature of the peat-mull, in the case of unripe fruits the ripening process is accelerated without causing shrinkage. In properly moistened, loosely spread out material, not only will the fruits be preserved but may even increase in weight and the colour and flavour is well developed. It takes from 5 to 7 times longer to evaporate the moisture in fruits if properly packed in dry peat-mull than would be the case if shelved and forwarded in the ordinary manner by insulated car. The antiseptic quality of peat-mull prevents bad fruits in a box contaminating the sound fruits

M. L. V.

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- 789 KOBER, H (Director) and SEILER, F (Stadtchemiker des Nahrungsmittel Untersuchungsamtes der Stadt Trier) Zusammensetzung und Beurteilung der Moselweines (Investigations and Data concerning Moselle Wines) *Zeitschrift für Untersuchung der Nahrungs und Genussmittel*, Vol 46, No 1, pp 1-9 Berlin, 1923

Tables giving the analytical results obtained with 221 Moselle wines, years 1920, 1921, 1922

F. D

790. Die Entkeimung der Obstsaft mittelst elektrischen Tauchheiden (Sterilisation of Fruit Juices with Electric Current) *Schweizerische landwirtschaftliche Zeitschrift*, Year 51, Pt 39, pp 961-962 figs 1 Zurich, 1923.

Note on the value of the electric current heater designed by SCHERER and manufactured by Bachmann and Kleinert at Oerlikon (Switzerland).

It can be regulated and gives a perfect sterilisation of grape or any other kind of fruit juice, without exceeding the desired temperature.

F. D.

791. FABRIS, G (Vice Direttore dei laboratori chimici delle Dogane e Imposte dirette) *Oli e grassi vegetali, animali e minerali*. (Oils and Fats of Vegetable, Animal and Mineral origin) Second edition, 160, pp. XXXII+671, figs 23. Milan, Hoepli, 1923

This handbook is divided into three parts : 1) fats of vegetable origin ; 2) fats of animal origin , 3) mineral oils, paraffin and vaseline. For each

of these classes of fats the author gives: the most common methods of extraction, purification and refining; commercial statistics, chemical composition, chief properties and characters with the method of determination; the commercial types and their essential characters, uses, possible methods of adulteration and their detection. Special attention is given to olive oil. The table of the characters of the vegetable oils and fats include 470 substances of which the many synonyms are given. In the chapter dealing with the hydrogenation processes there is a list of the patents granted to this industry from, and including, 1910. At the end of the book are 7 pages of bibliography (books and periodicals of a specialised character).

F. D.

792. BONNET, J. (Service régional de l'Oléiculture) L'huile de pépins de raisins (1) L'Usine d'Épuisement de la Coopérative de Distillation, «La Catalane» de Perpignan (Grape Pip Oil) *Office régional agricole du Midi, Bulletin trimestriel*, No 6, pp 42-52, figs 5. Marseilles, 1923.

The author describes the characteristic features of the factory. His study is divided into 3 parts dealing respectively with the following subjects. the aims of the grape-pip oil industry carried on at the Usine d'Épuisement de la Coopérative de Distillation «La Catalane»: the extracting plant and the economic results obtained, pomace treated 3 000 000 kg., dry grape-pips (20 % moisture) obtained 400 000 kg., oil extracted (trichloride) about 45 000 kg, staff 16, working days 100, amount of solvent used 2000 kg.

F. D.

793. FOSTER, I. D. Milling Qualities of New Zealand Grown Wheats. *The New Zealand Journal of Agriculture*, Vol XXVI, No 1, pp 1-7. Wellington, 1923.

Discussion as to the actual significance of "strength" in flours and causes of variation relative to climate, soil and variety of wheat, followed by a report of the milling tests made with New Zealand grown wheats by the Chemistry Section of the Department of Agriculture, demonstrating the good milling qualities obtainable in the Lake district.

M. L. Y.

794. GERUM, J. and METZER, C. (Untersuchungsanstalt Erlangen) Zur Kenntnis des Weizenklebers (On Wheat Gluten). *Zeitschrift für Untersuchung der Nahrungs- und Genussmittel*, Vol 44, No 2, p 87; Vol. 46, No 2, pp 74-86. Berlin, 1922-1923.

A study of wheat gluten, including a theory of the formation of gluten in wheat based on the chemistry of colloids; the increase of the phosphorus content of the gluten and decrease of the ratio between phosphorus and nitrogen with the increase of the rate of milling; effect of addition of rye gluten on this ratio.

F. D.

(1) See also H. ASTRUC L'extraction de l'huile de pépins à Perpignan (*Revue de Viticulture*, Vol LIX, No 527, pp 221-230, figs. 6. Paris 1923)

795. HEIM, F. and ROEHRICH. Etude Technologique d'une filasse d'agave d'Indo Chine. *Bulletin de l'Agence Générale des Colonies*. Year 16, No. 181, pp. 1-7. Paris, 1923.

Technological investigations on agave tow in Indo-China.

R. D.

796. BENJAMIN, L. R. The Manufacture of Pulp and Paper from Australian Woods. *Bulletin* No. 25, Institute of Science and Industry, Commonwealth of Australia, pp. 92, illustrations 4. Melbourne, 1923.

The Bulletin is a complete treatise on the subject of pulp and paper-making from Australian woods and is itself printed on paper made by the Institute, and also contains 7 sample sheets of different qualities of paper on each of which is printed particulars as to its composition, etc. The Publication refers to general processes of manufacture of pulp and describes investigations carried out with wood pulp and other fibrous materials; a detailed account is given of the experiments made, and the commercial possibilities of Australian pulp and paper are discussed.

W. S. G.

797. DEN BERGER, L. G., De grondslagen voor de classificatie der Nederlandsch-Indische timmerhoutsoorten (Classification of Dutch East Indian Timbers). *Lectona boschbouwkundig tydscrift*, Vol. XVI, No. 7, pp. 602-607. Buitenzorg, 1923.

Classification of Dutch East Indian timbers. The greater part of the marketable wood in the Dutch East Indies is sold as timber. Durability and strength are the most important features of timber, and on this basis the species are classified into 5 classes: 1) with regard to their durability (determined by experience); 2) with regard to their strength (cross-bending strength, resistance to compression along the grain and specific weight). The combination of these two classes of durability and strength determines their value as timber. Durability is the more important factor of the two.

D. v. S.

798. DE LONGUEVILLE E. Utilisation des Menus Bois. (Utilisation of Small Branches). *Bulletin du Comité des Forêts*. Year 10, No. 21, pp. 299-317 Paris, 1923.

Study of the possible utilisation of small branches as a source of ethyl alcohol in the manufacture of "Carburant National" for use in gasogenes. General information is given concerning the preparation and characteristics of the various French brands.

R. D.

799. FRY HOFER, C. W., and POTTS, R. C. (Division of Dairy and Poultry Products, Bureau of Agricultural Economics). Handbook for use in the Inspection of Whole Milk American Cheese under the Food Products Inspection Law. *United States, Department of Agriculture, Office of the Secretary, Circular 157*, pp. 1-16. Washington, D. C., 1923.

Rules and regulations relative to the inspection of American cheese. A brief summary of the regulations promulgated by the Secretary of

Agriculture under the food products inspection law ; an inspection service will be established in the following cities: Boston, New York, Philadelphia, Chicago, Washington, Fond du Lac, and San Francisco.

The grading of cheese will be determined based on the following factors : flavour ; body and texture ; finish and appearance ; colour. The approximate dimensions and weight of the commercial varieties are given including : Cheddars, Flats, Daisies, Young Americas, Long horns. Classification according to physical characteristics is dealt with in detail, with an accompanying chart of reference for certain scores and grades. G. Tg.

800. Milk and its Uses in the Home *U S. Department of Agriculture, Farmers' Bulletin*, No 1359, pp 1-19, figs 2 Washington, D C, 1923

Revised edition of this practical handbook which presents briefly the various uses to which milk can be employed in domestic economy. The question is dealt with from the following standpoints of milk:— infants, pasteurisation, care of milk in the home, milk products, and uses in cooking. G. Tg.

801 BIANCHARD, E (Directeur des services agricoles de Seine-et-Oise) *Pré-servation des récoltes en meules* (Preservation of Grain when Stacking). *Le Progrès agricole et viticole*, Year 40, No 33, pp 189-190 Montpellier, 1923.

Description of the method adopted by a farmer in Seine-et-Oise, who for twelve years, mixed salt with the oats when stacking, as a preventive against mould. The quantity of salt used was from 4-5 kg. per 1000 kg. of material (straw and grain) at a time when the harvest is comparatively dry. The germination capacity of the seeds is not in any way affected. This method is probably applicable to other cereals, and the author recommends farmers to adopt this idea especially when their crops have been soddened by the rain. F. D.

802 OWEN, Dr W L. (Bacteriologist to the Louisiana Sugar Experiment stations). *The Prevention of the Deterioration of Raw Sugar during Storage* *International Sugar Journal*, Vol XXV, No 294, p 32. London, 1923

Dr. OWEN's method depends on the inoculation of raw sugar with a certain yeast (a torula) acting only on reducing sugars with the formation of carbon dioxide, the development of moulds being prevented by this treatment. W. S. G.

PLANT DISEASES (1).

Diseases, non-parasitic or of unknown origin.

803 Root Disease of Sugarcane in Java, with special reference to the Variety EK 28.

KUIPER, J., Het wortelrot of Java, special in verband med de rietsoort EK 28. *Archief voor de Suikerindustrie in Nederlandsch-Indië. Mededeelingen van het Proefstation voor de Java-Suikerindustrie*, Year 1923, No. 4, pp 117-161, 2 figs. Soerabaya, 1923.

A monograph on the factors influencing the occurrence of root disease in Java and on the subsequent consequences specially in the case of the best variety planted now in Java viz., the seedling cane EK 28.

No special fungus or bacterium as a cause of root disease has been found in Java, nor have the studies in other countries thrown light on this point ; the author therefore undertook a careful investigation of those factors which were responsible in the first place for its appearance.

It is proved that anaerobic conditions of the soil, especially when caused by bad drainage or excess of irrigation water, or any form of moisture are very favourable to this disease. In low flat lands with bad drainage, where the level of the ground water is high, EK 28 can hardly be grown, but in deep, good, sandy soils with good drainage EK 28 is by far the best variety.

The anaerobic conditions are the more dangerous when organic matter is present in the soil ; the longer the land lies fallow after the cane crop, the better.

In Java, two systems of crop rotation are practised ; 1) cane is planted with an interval of 2 years ; 2) with an interval of three years. The latter system proves to be the best in relation to root disease.

Inconstancy of the water content of the soil, rapid and frequent changes seem to aggravate this disease.

The author discusses the question of soil sickness and organic poisons in the soil ; he does not think it necessary to present these facts relative to the disease. The disease is not spread by the seed ; succulent planting cane, which is easily attacked by putrifying organisms, favours, however, the disease by causing an anaerobic medium around the young roots.

The Java planters fear that the disease is spreading more and more ; by means of numerous tables and figures it is shown that no proof can be given for this opinion. EK 28 formed 2 % of the total area planted with cane in 1916, 40 % in 1922 ; the area with root disease increased during these years absolutely but not relatively.

Climatic conditions also have a great influence, one year showing a small area with root disease, another a much larger one. The predom-

(1) See Orig. Art p 823, and Nos. 336, 348, 601, 614, 633, 637, 666, 668, 763 of this Review (Ed.).

ant influence of climatic conditions on the crop of the different cane varieties is also dealt with in this connection.

When the cane is once attacked by root disease on a certain field, it may remain immune when planted in the next rotation on the same spot, this depends largely on the cause of the disease, which may originate as a result of inadequate treatment of the soil, or in an unfavourable situation of the field (*e. g.* too moist as a rule) which cannot be changed.

Notwithstanding its susceptibility to root disease the variety EK 28 is the best in Java, also in many plantations where the disease is prevalent. The average crop of 40 % of the total cane-area of Java planted with EK 28 is much higher than the general average crop. The author advises the planters to combat the disease by means of careful drainage, cultivation, tillage and irrigation, in order that the full benefit may be derived from this superior cane variety, and it is emphasised that good cultivation is one of the best means for the control of pests and diseases.

J. K.

804. Is "Bramble-leaf" of the Vine, a Disease Caused by Protozoa?

PETRI L. L'arricciamento della vite è una malattia prodotta da protozoi? *Rendiconti delle sedute della Reale Accademia Nazionale dei Lincei*, Classe di Scienze fisiche, matematiche e naturali, First half-year, 1923, Vol XXXII, Part. 8, pp. 395-397, fig 1. Rome, 1923

A cytological examination of vine-leaves attacked by bramble leaf ("roncet", "arricciamento"), has revealed the presence, in the leptom of the principal veins, of elongated bodies of wavy outline, sometimes with filaments at the pole, which stain very deeply. In many cells, these bodies are found near, or in contact with, the nucleus which shows evident signs of chromatolysis.

These observations of the author agree very closely with the results of recent researches made by R. NELSON, who found protozoa in the phloem of tobacco plants, *Leguminosae* and tomatoes suffering from mosaic disease, as well as in potato-plants affected by leaf-curl.

The author, however, remarks that before mosaic and leaf-curl can be regarded as diseases due to protozoa, it is necessary for the results of the cytological researches to be confirmed by the isolation of the supposed pathogenetic forms.

G. T.

Plant parasites.

805. Cupric Mixture and Lime Sulphur Mixtures as Fungicides.

CHABROLIN, C Les bouillies cupriques et les bouillies sulfocalciques dans la lutte contre les maladies des arbres fruitiers. *Journal de la Société Nationale d'Horticulture de France*, Series 4, Vol. XXIV, pp 251-252. Paris, 1923

After having laid stress upon the great economic importance of diseases of fruit-trees in France, the author gives detailed information res-

pecting the preparation, composition, properties and application of the following substances used for their control : cupric mixtures, sulphur-lime mixtures and mixed arsenical compounds. The author has reached the following general conclusions :

1) The anticryptogamic power of cupric mixtures is due to the copper they contain.

2) The most useful cupric mixtures for fruit-trees are alkaline Bordeaux mixtures containing nearly equal weights of copper sulphate and of lime.

3) Sulphur-lime mixtures have less anticryptogamic effect than copper compounds, but in many cases, are quite effective.

4) Sulphur-lime mixtures possess a certain number of special advantages which should determine their application in particular cases.

5) Usually, however, the chief merit of sulphur lime mixtures is their cheapness, as they cost less than copper mixtures.

6) As a rule, the best results obtained from mixed treatments in the control of the scab of apple and pear trees (*Fusicladium dendriticum* and *Fus. pirinum*), and of *Laspeyresia pomonella*, which attacks both apple and pear trees, are given by very alkaline Bordeaux mixtures containing a certain amount of lead arsenate

7) Sulpho-lime mixtures to which has been added lime arsenate also give good results in these mixed treatments.

8) Arsenical mixtures are best for spraying apple and pear trees after they have finished flowering

9) For treating fruit-trees, high pressure spraying syringes suited to the special requirements of French arboriculturists should be employed.

G. T.

806. Diseases of Maize, Sorghum and other Gramineae produced by *Helminthosporium* in India.

MITRA M *Helminthosporium* spp on Cereals and Sugar-Cane in India. Part. I (Diseases of *Zea Mays* and *Sorghum vulgare* Caused by Species of *Helminthosporium*) *Memours of the Department of Agriculture in India, Botanical Series*, Vol XI, No 10, pp 219-242 Tables 3, Calcutta, 1923.

Most of the Graminae cultivated in India are commonly attacked by species of *Helminthosporium* which frequently cause considerable injury.

As a rule, these Hyphomycetes infest the leaves and the inflorescences, making yellowish brown patches that often coalesce so that the leaves are completely destroyed.

Hitherto, the following species of *Helminthosporium* have been recorded from the Gramineae grown in India : *H. Avenae* Br. and Cav. (on oats), *H. gramineum* Rabh. and *H. teres* Sacc. (on barley), *H. turcicum* Pass. (on maize and sorghum), *H. nodulosum* B. and C. (on *Eleusine coracana* and *E. aegyptiaca*), *H. Sacchari* Butl. (on sugar-cane). In addition, others have been collected in different localities. *H. Oryzae* Miyabe and Hori (on rice), *H. flagelloideum* Atk. (on *Panicum*), while on wheat

(in Burmah, Nagpur, Poona and Pusa), a form which appears to be a variety of *H. teres* has been found. Representatives of the gen. *Helminthosporium* have also been observed on certain wild Gramineae (*Cynodon*, *Andropogon*, *Panicum* and *Eleusine indica*).

The present work deals with the diseases of *Zea Mays* and *Sorghum vulgare* ("jowar") caused by *Helminthosporium*. It contains a description of the behaviour of the parasite when cultivated on the various media used and of the results obtained by cross inoculation in other important cereals and sugar-cane.

The author's work has shown that the fungus (*H. turcicum*) living on maize is morphologically identical with the form that develops on sorghum. The strains obtained from these two host plants differ, however, from the cultural point of view, further, it has been found that, in Bihar, *Helminthosporium* is only found on maize, whereas in the Punjab, it occurs solely on sorghum.

These two facts have induced the author to regard the fungus attacking sorghum as belonging to a different line from that occurring on maize.

H. turcicum is a parasite found on maize in nearly all the parts of India where this cereal is cultivated. In Bihar, it is the cause of a very serious disease of the maize crops, occurring on the leaves and male inflorescences; its parasitic character has been proved by inoculation experiments effected on both host plants.

H. turcicum can be cultivated on a large number of media, but on none of them has the perfect state of the fungus been observed.

Infection takes place either through the stomata, or as a result of the perforation of the epidermis and subsequent penetration into the underlying cells. Cross inoculation has shown that lines of *Helminthosporium* taken from either maize, or sorghum, can infect maize, sorghum, wheat, barley, oats and sugar-cane. The inoculations into *Pennisetum* gave negative results and those into rice were uncertain in their effect.

G. T.

807. *Botrytis cinerea*, and *Ascochyta Pisi* Injurious to *Lupinus angustifolius* in New Zealand.

CURTIS, K. M., Two Fungal Diseases of the Blue Lupin. *The New Zealand Journal of Agriculture*, Vol XXVI, No 4, pp 240-246, gs 10. Wellington, 1923

In different localities of Nelson, (New Zealand), where *Lupinus angustifolius* is cultivated, both for seed and for a green manure for the orchards, on small plots usually at wide distances apart, the plants have been found lately to be attacked by two diseases, one the more common, due to *Botrytis cinerea* Pers., and the other caused by a species of *Ascochyta* provisionally identified by the author as *Asc. Pisi* Lib.

From the economic point of view, the first of these two fungi is more important than the other because it attacks cultivated plants of *L. angustifolius* rather than wild seedlings. When the stem is severely infected the leaves turn yellow and fall, thus leaving the top of the plant bare. If

the plant is growing vigorously when attacked, the stem remains erect till it dies, but in weak seedlings that have sown themselves, the stem often bends over at the point of infection and the lupin falls to the ground. Sometimes only one branch is attacked, in which case, the leaves only fall from the diseased part of the plant. As a rule, the lesions due to the parasite occur at the level of the ground, but sometimes they are found also further up the stem. The disease generally spreads all round the stem and the external tissues are invaded with the fungal hyphae.

The second disease most often attacks cultivated lupins, and especially the weaker individuals. The stem may be infected at the level of the soil, but the lesions are usually observed higher up the stalk. Although sometimes only one large lesion is produced, it is frequently accompanied by other small lesions occurring either above or below. Occasionally the branches are infected, the stem remaining healthy in some cases, though in others it becomes diseased. The general symptoms of the disease resemble those produced by *B. cinerea*, but since the plants are usually weaker, the disease makes greater inroads and the plants soon perish.

The best precautionary measure to adopt against both the diseases is to avoid planting *L. angustifolius* in damp places, as moisture is the factor that chiefly regulates the spread and virulence of cryptogamic infection. If well-drained land cannot be obtained, the plants must be grown far enough apart to allow free circulation of air around the stems. Only seed from immune fields should be planted. If the diseases have infested a field, recourse should be had to rotation of crops.

G. T.

808. Treatment for Protecting Cotton Seed Against the Attacks of *Colletotrichum Gossypii*.

LIPSCOMB G. F. and CORLEY G. L. On the Vitality of Cotton Seed. *Science*, New Series, Vol. LVII, No. 1487, pp. 741-742. Utica, N. Y., 1923.

Colletotrichum Gossypii Southw., the cause of the so-called anthrac-nosis of cotton is a very widely spread and serious disease in the United States of America, and as it infects the seeds, is propagated from one year to another.

The authors, after making repeated experiments on cotton seed (var. Weber 49), somewhat severely infected by the parasite, have found that seeds which are thoroughly dried and exposed to the action of heat in a vacuum, or inert atmosphere, like nitrogen, in order to prevent the oxidation of the fats and protein they contain, can resist a temperature of 100° C. for twenty-six hours without any decrease in their vitality, whereas the fungus is completely destroyed.

Further, the germination percentage of seeds thus treated is much higher than that of untreated seeds.

G. T.

809. *Volutella Petri*, n. sp., a Hyphomycete Parasite of *Ficus elastica* in Piedmont (Italy).

CIPERRI R. Su di un cancro del *Ficus elastica*. *Rivista di Patologia vegetale*, Year XII, Nos. 5-6, pp. 85-90, figs. 2 Pavia, 1923.

In a garden of Verrua Savoia (Prov. of Turin), there is a fine specimen of *Ficus elastica*, but a longitudinal crack, which becomes deeper every year runs down its trunk. Part of this crack has a border of wound-callus upon which are to be seen small, white bodies that an investigation proved to be the sporodochi of a *Tuberculariaceae* belonging to the genus *Volutella* and described by the author as a type new to science under the name of *V. Petrii*.

The fungus has been cultivated, but only the mycelium could be obtained, there being no formation of conidia, or of any metagenetic form. The disease has been reproduced with its original characters on a well-developed, healthy young plant some three years of age. G. T.

810 *Pseudoperonospora Humuli*, *Cercospora cantuariensis* and *Macrosporium* sp., Micromycetes reported for the First Time on the Hop in England.

SALMON, E. S., and WORMALD, H. Three New Diseases of the Hop. *The Journal of the Ministry of Agriculture*, Vol. XXX, No. 5, pp. 430-435, tables 2. London, 1923.

In the experimental hop-gardens of the Wye Agricultural College, Kent, *Pseudoperonospora Humuli* (Miyabe and Takah.) Wils., was found for the first time in October 1920, on the leaves of some hops grown from the seed of wild hops coming from Italy, and in September 1922, the characteristic angular patches produced by the fungus were discovered on the leaves and fruits of numerous hops plants of various origin. This parasite which is new to England has probably been introduced there from Japan, or America. It is much to be feared that in damp years *Pseudoperonospora Humuli* may develop into a serious pest, therefore on its first appearance on hop-plants, the infected leaves should be removed, taken far away from the hop-garden and burnt, while the whole plants ought to be freely sprayed with Bordeaux mixture.

In September 1922, the leaves of some of the "Canterbury Golding" variety of hop grown in the vicinity of Canterbury showed round patches with a central greyish, or almost white portion surrounded by a line of dark purplish-brown beyond which was seen a yellowish zone that gradually merged itself into the green of the healthy areas. These patches have been shown by microscopic investigation to be produced by a species of *Cercospora* that is new to science, and has received from the authors the name of *C. cantuariensis*.

Lastly, in the same month of September 1922, the fruits in a hop-garden near Canterbury were observed to fall before they were ripe enough to gather. The varieties that behaved in this manner were Cobbs and Canterbury Golding. The fall of the fruit was preceded by the discoloration

of the peduncle which became unable to sustain the weight of the cone. As the blackening of the peduncle was always associated with the presence of a species of *Macrosporium*, it is though that this fungus is probably the cause of the disease, although so far, it has not been possible to decide the matter by means of inoculation experiments. Possibly this species of *Macrosporium* belongs to the class of parasites that are only able to attack their host-plants when the latter are in a condition of physiological debility.

G. T.

Animal parasites.

811 **Potato Tuber Moth (*Phthorimaea operculella*) on Tubers imported into Brazil.**

MAGARINOS TORRES, A. F., Uma terrível praga da batatinha, *Phthorimaea operculella*, (Tell) Meyr. *Chacaras e Quintões*, Vol. XXVII, No. 6, pp. 393-499, figs. 4. S. Paolo, 1923.

Amongst the load of 60 tons of potatoes exported from Norway, was noted on arrival in Brazil certain tubers attacked by the potato tuber moth (*Phthorimaea operculella*), in various stages of development.

Attempts were made without delay to prevent further damage, but unfortunately 30 tons of tubers had already been removed from the Customs and it was not possible to follow them up.

In order to draw attention of farmers in Brazil to the injuries caused by *Phth. operculella*, the author has given a description of the life history of this microlepidopteron, with reference to the economic importance and the means of control.

G. T.

812 **The Control of the "Olive Fly" (*Dacus oleae*) in Italy.**

PINOLINI, D., Uno sguardo agli olivi. *Il Risveglio agricolo della Provincia di Macerata*, No. 6, p. 48. Macerata, 1923.

The olive-growers of the Province of Macerata have found as a result of experiments that the first generation of the "fly" can be driven away by treating the olive-trees liberally when in full flower with a homogeneous mixture of equal parts of sulphur, powdered quicklime and sifted coal dust.

When the fruits have reached the size of small peas, spraying the olives with ordinary Bordeaux mixture is a very effective remedy against *Cycloconium oleaginum*. The same treatment repeated forty days later has also proved successful in controlling the "olive-fly".

G. T.

813 ***Plesispa reichel*, a Beetle Injurious to the Coconut Palm, in the Malay Peninsula.**

CORBETT, G. H. Preliminary Note on the Two-Coloured Coconut Leaf Beetle (*Plesispa Reichel* Chap.) *The Malayan Agricultural Journal*, Vol. XI, No. 3, pp. 64-69. Kuala Lumpur, 1923.

The Chrysomelid, *Plesispa reichel* Chap., is a very destructive parasite attacking the coconut palm throughout all the Malay Peninsula. The

author gives a description of the different stages of the beetle both from the morphological and the biological standpoint.

The larvae, as well as the adult insects, live at the expense of the upper and lower surfaces of the palm-leaves, their attack being confined to the folds of the young, unexpanded leaves and continued in a straight line. Very frequently, the beetle on reaching a certain distance from the initial point of attack, returns in a line parallel to its first path. It eats away the tissues in its progress so that both lines coalesce, while the rest of the leaf dries up and withers. Finally, the leaf tears and the young plant looks as if it has been damaged by the wind. The growth of the palm is much hindered, and if the attack is severe and of long duration, the plant dies.

The beetle is especially injurious to seedlings in the nursery, and to young trees two or three years of age growing in the open. Seedlings a few years old suffer severely if attacked, but the greater extension of leaf-surface prevents old trees being much injured unless they are infested by a large number of the adult insects. It has not been ascertained with any certainty whether the beetles generally spread to the older palms, for although they have often been found upon them, their attacks were confined to individuals already in bad health and growing under unfavourable conditions.

Pl. reicheri has hitherto only been found on one plant beside the coconut-palm, viz., *Oreodoxa regia*. A chalcid hymenopteron egg-parasite of *Pl. reicheri* has recently been discovered, but the preliminary investigations so far made have revealed but few parasitised eggs.

When the coconut-palm grows under healthy conditions, it suffers little permanent injury from the attack of the beetle, since the leaf-surface is continually increasing. It has been found that where the nurseries are shaded by adult coconut palms, the larval and adult forms of *Pl. reicheri* retard the growth of the seedlings, hence a clearing should be made for the nursery and the necessary shade obtained from trees other than the coconut palm.

Before the young plants are placed in the open, they must be freed from any eggs, larva, pupae, or adult forms of the beetle. This may be done either by hand-picking, or by immersion in a 0.48 % solution of lead arsenate. If after the first bath the seedlings are exposed to heavy rain, a second treatment may be required before they are planted out. Any young larvae that hatch out after the seedlings have already been planted must be destroyed by spraying with the same mixture. In cases where the insects appear on young trees in the plantation, a thorough treatment with lead arsenate every three weeks, provided the spray is well directed into the centre of the plant, will probably prove more economical and effective than hand-picking.

G. A. I.

814. Dichlor-benzol in Control of Sugar Cane Pests.

JARVIS E. (Entomologist, Meringa Queensland Australia), in « Sugar », Vol 24, pp. 552-553. New York, 1922.

The author has carried out experiments, extending over several years with a view to the discovery of an efficient, easily managed fumigant for

cane grubs. Many substances were tried such as pungent oils and poisons, the latter being mixed with suitable compounds in order that they might be handled with safety in field work. Several of these gave good results in the laboratory, but were not so satisfactory when tested in the open on a large scale.

Dichlor-benzol, the commercial name of paradichlorobenzene, is a semi-transparent crystalline substance with a penetrating odour very much like that of ordinary benzene. In 1915 laboratory experiments were carried out and also field tests, in which $\frac{1}{4}$ oz. (7 gms) injections of the fumigant were made at a depth of 5 inches below the surface of the soil and one foot apart. Larvae of the greyback beetle (*Lepidoderma hirta*) were buried in the soil at various distances from the chemical each larva being confined in a cage which allowed it to move in a vertical direction only, from near the surface to a depth of 9 inches. After nine days the soil was examined and found to be impregnated with the odour of the chemical. Larvae at a distance of 8 inches were dead, those at 9 inches were dying, but those at 1 foot were unaffected. The test was repeated with similar results. These experiments were repeated in 1922 and were again successful.

Dichlorbenzol, under such conditions evaporates in about four months.

This chemical should prove to be a satisfactory fumigant for plant cane, as it would be put into the furrows when planting, and would render the soil on each side of the sets distasteful to the beetles, and would deter them from ovipositing in the fumigated ground; or, if eggs were deposited, the grubs would certainly be killed on hatching. At 6d per lb. the cost per acre would not exceed £ 2. Dichlor benzol is harmless and clean to handle and in no instance has the use of this fumigant been followed by injury to sets nor to growing cane plants.

G. T.

815. *Laphygma exigua*, a Macrolepidopteron Injurious to the Sugar-Beet and Other Plants in the Basin of the Ebro (Spain).

Communicated by Signor JOSÉ CRUZ LAPAZARÁN, Chief Agriculturist of the Agronomic Service of Saragozza and transmitted by Signor FRANCISCO BILBAO Y SEVILLA Agricultural Expert, Delegate of Spain at the International Institute of Agriculture

In 1923, a year in which sugar-beets were cultivated in the basin of the Ebro over an area of over thirty-five thousand hectares, the crops in the district of Aragon and to a lesser extent those in Navarre, Rioja, and Catalonia were attacked by the macrolepidopteron *Laphygma exigua* Hbn. (fam. Noctuidae).

The first generation of the insect almost escaped notice as is shown by the appearance of large centres of infection in the provinces of Lerida (Segre zone) and of Saragozza, a valley of the Ebro. The second generation appeared in June and July and spread so rapidly, that control measures had to be at once begun. The third generation attacked with more or less intensity the whole district under sugar-beets. The eggs of the second and third generations were laid by preference on the leaves of lucerne, cap-

sicum, and sugar beet, although they were found also on those of common wild plants like the Lesser Bindweed (*Convolvulus arvensis*), whence the insects found their way to cultivated plants. The eggs of the fourth generation of insects which were destined to propagate the species, were laid under clods of soil.

In addition to the three above-mentioned plants, which are the favourite hosts of the macrolepidopteron, spinach and tomato-fruits were also attacked, while incidentally beans, and even apples and other fruits, were infested.

When the larvae attacked the leaves of the sugar-beet, nothing was left but the veins. The roots were severely injured in their upper portions, but the central and lower parts escaped. It is estimated that the beet-crop was reduced by about three hundred thousand tons as a result of the depredations of this insect. All the beans and lucerne crops of July were completely lost, and the capsicum crop which is of great importance in Aragon was almost completely destroyed.

In order to meet the requirements of the control campaign against this insect it was necessary, in view of the extension of the infested zone, to use all the insecticides procurable on the market. Sprays of the following solutions proved the most efficient means of destroying the larvae.

a) arsenate of soda	500 gm
fresh slaked lime	500-1000 gm
water	100 litres
b) copper arsenite	400 gm
fresh slaked lime	400-500 gm
water	100 litres.

Since the insects pupate near the roots of the plants at a depth of three to four centimetres, the chrysalides can be killed if the irrigation water is allowed to collect.

Measures were also taken, but to a much more limited extent, for the nocturnal destruction of the adult insects.

Irrigation and ploughing destroyed nearly all the eggs of the fourth generation which had been deposited beneath clods of soil.

816 The Coccid, *Pseudococcus citri*, Injurious to Coffee in Guatemala.

El piojo blanco de los cafetales *Boletín de Agricultura, Industria y Comercio de Guatemala* Series, 2, Vol. II, No 7, pp 284-286. Guatemala, 1923.

The coffee bush is included among the numerous host plants of *Pseudococcus citri* in the Republic of Guatemala, for this parasite has been found by coffee growers in the territory of Pueblo Nuevo (Department of Retalhuleu), and in that of Quetzal (Department of San Marcos), as well as in the zone of Xolhuitz.

Fumigation with poisonous gases and spraying with insecticides have not been as effective against *Ps. citri* as was hoped. The best mechanical means is the direction of a strong jet of water upon the points attacked

by the scale-insect, but the use of the natural enemies of the parasite has proved the most reliable method for its control. Recent investigations have revealed the presence in a single coffee plantation of five Coccinellae that are foes of *Ps. citri*, but they have been unable to exert their influence to the fullest extent, because the Coccids are protected by ants. The best way of controlling the latter is by spreading poisoned sugar baits on the coffee trees, or by putting a band of viscous substance round the trunk to prevent the ants crawling up.

G. T.

817 *Phytomyza platensis* n. sp. a Dipteran Injurious to the Ornamental Labiate *Salvia splendens*, Controlled by the Hymenoptera *Phytomyzophaga albipes* n. sp. and *Paracrias phytomyzae* n. sp. in Argentina.

BRÈTHES J. Sur un diptère mineur des feuilles de *Salvia splendens* et deux Hyménoptères ses parasites *Revue de zoologie agricole et appliquée*, Year 22, No 6, pp 153-158, fig 2. Bordeaux, 1923.

The leaves of specimens of *Salvia splendens* (an ornamental Labiate of Brazilian origin), growing in Buenos Aires, have been observed to be mined by straight, or winding galleries of a maximum width of one millimetre. These excavations are produced by an insect which, as a result of artificial breeding, has proved to be a member of the genus *Phytomyza* and is described by the author under the name of *Phvt. platensis* n. sp.

This dipteran is parasitised, in the proportion of about 70, % by two new species of hymenopteron described by the author and named by him *Phytomyzophaga albipes* and *Paracrias phytomyzae* respectively

G. T.

818 The Coccid, *Icerya purchasi*, reported for the First Time in the Gironde (France).

FEYTAUD, J, Sur une apparition d'*Icerya purchasi* dans un jardin d'Arcachon. *Revue de zoologie agricole et appliquée* Year 22, No 7, pp 196-201, figs 2 Bordeaux, 1923

At the end of September 1921, the coccid *Icerya purchasi* was found in the garden of the villa Fée-des-Eaux, at Arcachon, on three pot-plants (2 of *Mimosa Baileyana* and 1 of *M. decurrens*), that had been bought in the previous March. *I. purchasi* is a new species in the Gironde, but for nearly ten years, it has formed a part of the French fauna.

Although energetic measures were taken to prevent the spread of the parasite from this small centre, the mild climate of Arcachon favours the acclimatisation of the insect, and in 1922 two of the females were observed in the act of oviposition on plants of *Mimosa*. Since the spring of 1923, however, no further individuals have so far been seen, therefore it appears that all danger of infection from this centre in the South-West France has been removed.

G. T.

819. Fruit Fly Damage to Fiji Citrus Fruits and Importation Regulations in New Zealand.

WRIGHT, C. H. (Government Agricultural Chemist) The Citrus Industry in Fiji. *Bulletin of Miscellaneous Information, Royal Botanic Gardens Kew*, No. 7, pp. 261-264. London, 1923.

Since the introduction of citrus fruits into Fiji, about 1883, the cultivation of limes oranges and mandarins has become very generalised. The author gives details of the regulations adopted by the New Zealand government with reference to importation of citrus fruits from Fiji, owing to the fruit fly damage (*Dacus passiflorae*) reported in certain orchards, also found on other fruits such as guava, mango, passion fruit, dawa (*Pometia pinnata*) and *Eugenia malaccensis*. According to the Government Entomologist reports, the worst pest is the *Dacus rarotongensis*, and strict rules are followed for discarding attacked fruit before shipping; special sheds with openings covered with wire gauze have been erected and the fruits remain in these at least 5 days before packing, and are sorted and packed under careful supervision. The mandarins thus treated have arrived at their destination in satisfactory condition and subsequent shipments have shown the commercial possibilities of citrus fruits exported from Fiji.

M. L. Y.

820. *Pulvinaria floccifera*, a Coccid Injurious to Orange Bushes and new to Catalonia (Spain).

AGUILÓ, J., GARSOT, J. Una malatia nova dels tarongers de Catalunya. La pulvinaria floccifera. *Agricultura*, Year VII, No. 18, pp. 496-498 Barcelona, 1923.

During the last four years, a coccid which has only been recently identified as *Pulvinaria floccifera* (Westw.) Green and is new to Catalonia, has been observed on orange bushes at Cambrils. At first, only sporadic cases occurred, but from these centres the parasite spread in all directions.

In Catalonia, the natural enemies of this coccid are the predatory beetle *Exochomus 4-pustulatus* L. (in the larval state), and a hitherto undetermined parasitic Ichneumonid Hymenopteron.

As regards the artificial control of *Pulvinaria floccifera*, satisfactory results have been obtained by spraying the trees every month from May to October with a solution composed of lysol (3.50 litres) and water (96.50 litres).

G. T.

821. *Lymantria dispar* on Oak Trees in Algeria.

DALASSUS, Le *Lymantria dispar* en Algérie *Revue agricole de l'Afrique du Nord*, Year 21, No. 211, pp. 320-324, fig. 1. Algiers, 1923.

The Gypsy moth (*Lymantria dispar*) has been observed during 1923 on oaks in several parts of Algeria (Palestro, M'Sila and especially near Bona). In the last named area, in June, more than 300 hectares were attacked in the Edeugh and Bugeaud localities. The trees were defoliated

rapidly and gave the appearance of a forest fire. New shoots were then produced and the trees presented a normal aspect, but on the trunks an exceptional number of eggs deposited by this macrolepidopteron were observed.

A full description of the adults, larvae and eggs of *L. dispar* are given and the means of control which have proved the most satisfactory.

G. T.

822. *Phenacoccus peyerimhoffi*, n. sp. Coccid on *Juniperus thurifera* in Algeria.

VAYSSIÈRE, P., Un nouveau Coccide (HEM) de la faune africaine. *Bulletin de la Société entomologique de France*, Nos. 11-12, pp. 152-155, figs. 2. Paris, 1923.

Description of the new species *Phenacoccus peyerimhoffi*, observed in June 1922 on *Juniperus thurifera*; the conifer growing locally in certain parts of the Aures range in Algeria. The Coccid *Thea thurifera* Sicard is known to attack the *Ph. peyerimhoffi*.

G. T.

BIBLIOGRAPHICAL NOTES.

823 VERMOREL, V., Destruction des mauvaises herbes par l'acide sulfurique. *Revue de Viticulture*, Year 30, No 1511, pp. 439-442 Paris, 1923

Detailed description of the methods employed for the destruction of weeds by the use of sulphuric acid; the time of application, preparation of mixture, spraying and precautions which should be taken.

R. D.

824. ROEBUCK A (Adviser in Agricultural Entomology, Harper Adams Agricultural College, England) *Insect Pests and Fungous Diseases*. Price 2/- (Successful Farming Series), Benn Brothers Ltd. London

A practical pocket-manual of the chief insect pests and fungus diseases found on farm crops, with illustrations, descriptions and methods of control.

W. S. G.

CURRENT NOTICES

Legislative and Administrative Measures.

Law relating to Sale of Agricultural Seed in Australia (West) (February 22, 1923). — Under the terms of this law, the Governor is empowered to fix the minimum germination percentage of a specified quantity of agricultural seed, and the proportion or quantity of impurities, or of weed-seed, permissible in a given amount of agricultural seed. The law contains provisions for sample-taking, seed examination by a botanist and for issuing certificates, and also states the penalties incurred by infringement of its provisions (13 *Geo V*, No 44).

Decree relating to Cotton and Jute Experiment Station in Brazil (January 24, 1923). — No. 15 939 creating a Station in the Commune of Piracicaba, State of S Paulo (*Diario Oficial*, No 24).

Decree relating to Nitrogen Industry in Brazil (July 18, 1923). — Decree fixing the favourable terms to be granted to firms, or legally constituted Companies in the country having as their object the exploitation of the atmospheric nitrogen industry and engaged in the manufacture of chemical fertilisers (*Diario Oficial*, No 180).

Decree establishing Cotton Service in Brazil. (August 17, 1923). — Decree No 16122, established with the object of development and improvement of cotton production in Brazil by adopting certain advantageous measures relative to cultivation, preparation, and yield. The duties of this Service include in brief: *a*) the study of the productive areas in Brazil, *b*) recommendations to cotton growers as to preparation of soil, methods of cultivation, etc., *c*) establishment and upkeep of Seed testing Stations, etc.; *d*) collaboration with the "Institut Biologique de Defense agricole" in the control of cotton diseases and pests; *e*) facilities as regards sale of seeds of superior quality, of fertilisers, agricultural implements, etc.; *f*) establishment of a trade mark for cotton gins, in order to guard against fraud; *g*) fixing of cotton standards to serve as a base for classification and local sale; *h*) encouragement of uniformity in produce in the export centres (model factories); *i*) the development of cotton growing and trade (bursaries, Co-operative Societies, country savings banks); *j*) organisation of general statistical enquiries concerning area exploited, yields, etc.; *k*) distribution of seeds of superior quality, practical pamphlets and illustrated leaflets, etc.; *l*) control of contracts arranged on the one hand by the Federal Government and on the other by the cotton and oil factories.

The decree holds itself responsible for the organisation of the Cotton Service and the State subsidies involved (*Diario Oficial*, No. 229, Oct. 3, 1923).

Law relating to Cotton in British India (March 16, 1923). — Act for the establishment of a fund for improving and developing the cultivation, sale and spinning of cotton in India (*Act* No XIV, of 1923).

Canadian Government Standards for Canned Fruits and Vegetables. — Two enactments are in force viz, the Food and Drugs Act and the Meat and Canned Foods Act, the first deals with the purity, wholesomeness and weight of all food products and the second with the sanitary conditions of the plant in which manufactured, and the soundness of the raw material and demands a correct description of the product on the label. This Act and Regulations made thereunder, applies to wherever export or interprovincial trade with fruits and vegetables is in force, and where fruit and vegetable products, or milk are canned, evaporated, dried or otherwise prepared for food, and to places where such products are stored previous to utilisation for trade purposes. Four standards of quality have been legalised and clearly defined, and in addition to general standards for vegetables, specific grades have been established for canned peas. Canned fruits are graded for quality and syrup. Export and import regulations are duly enforced (*Agricultural Gazette of Canada*, Vol X, No 3, pp 225-229 Ottawa, 1923).

Law regulating Sale of Fruit in Canada (June 13, 1923). — This law regulates the sale and inspection of fruits and the receptacles in which they are packed. It states the qualities of the fruits grown in Canada. The law also contains provisions relating to the marking of closed receptacles (cases, barrels) and open boxes, and to packing, stamping, the size of the cases, etc. (*Statutes of Canada* 13-14 Geo V, Vols I-II, Chapt 15 (1923)).

Decree relating to Agricultural Instruction in Columbia (March 3, 1923). — Decree No 289 organising the Higher Veterinary School. (*Diario Oficial* Nos 18835 and 18836).

Decree No. 268 (February 26, 1923) re-establishing the Higher School of Agriculture. (*Diario Oficial*, Nos. 18825 and 18826).

Water Inspection in Costa Rica (May 9, 1923). — Decree No. 15 dealing with the establishment and regulation of a Service of Water Inspection in all the provinces of the Republic (*La Gaceta*, No 108).

Decree relating to Agricultural Instruction in Italy (July 22, 1923). — Royal Decree No. 1860 containing the provisions for the foundation of a Practical School of Agricultural Machinery in Rome. (*Gazzetta Ufficiale*, No. 211, September 7).

Viticultural Station in Italy (July 29, 1923). — Royal Decree No. 1796 relating to the foundation of an Experimental Vine-Growing Station at Conegliano in connection with the Royal School of Viticulture and Oenology. (*Gazzetta Ufficiale*, No 201, August 27).

Decree relating to Silkworms in Italy (March 29, 1923). — Royal Decree suppressing the Council for the Promotion of the Interests of Sericulture together with its Permanent Committee and appointing a Permanent Committee for Silkworm Rearing and the Silk Industry. (*Gazzetta Ufficiale*, No. 114).

Application of Law relating to Contagious Diseases of Domestic Animals in Japan (January 19, 1923). — Provisions relating to the appli-

cation of the law dealing with measures for the control of the contagious diseases of domestic animals. The animals in question are as follows: cattle, horses, sheep, goats, swine, dogs, fowls and ducks. The various amounts and maximum sums given in compensation are stated, as well as the method adopted to apportion the expenses involved in the prevention of tuberculosis in cattle, and of other contagious diseases. The decree contains regulations relating to quarantine, the sale of serums, etc., and the different methods of disinfection to be adopted etc. Kwampô (*Official Journal*, No 3138).

Organisation of Phytopathological Service in Grand Duchy of Luxemburg (September 24, 1923). — Decree concerning the organisation and functioning of the Phytopathological Services of Horticultural Establishments (*Mémorial du Grand-Duché de Luxembourg*, No 49).

Rights of Importation in Mexico (June 13, 1923). — Decree exempting from all consular, or importation dues any material introduced into the national territory for the construction of large water-works (*Diario Oficial*, No. 43).

Order relating to Imported Animals in Mexico (June 1, 1923). — Decree ordering prophylactic baths for all animals imported into the Republic if they are infected with external parasites (*Diario Oficial*, No 59).

"Dahir" Encouragement of European Cultivation Methods in Morocco (June 23, 1923). — Instituting a prize for the encouragement of the extension of European cultivation methods (*Bulletin officiel du Maroc*, No 558).

Regulation concerning Cotton in Nyasaland (May 31, 1923). — According to this Regulation, any land-owner, or other persons, planting cotton in the Protectorate must pull up and burn all cotton plants growing on his land whether planted by him or not, before the last day of the October following the date of plantation (in certain districts the term is extended to January 31). No cotton seed shall be distributed to the natives before it has been passed by the Director of Agriculture. This Regulation also deals with the sale and purchase of cotton and the licences required for these purposes (*Nyasa Government Gazette*, Vol XXX, No 7).

Order exempting Exportation Dues on Vanilla in Oceania (French) (March 30, 1923). — Order regulating the gathering, transport, preparation and export of vanilla and lianes throughout all the French Stations in Oceania and fixing the method in which the taxes on exported vanilla should be assessed, paid and collected. (*Journal officiel des Etablissements français de l'Océanie*, No 83).

Order relating to Packing Materials for Fruit exported from Paraguay (April 2, 1923). — Decree No. 15922 amending Art. 11 of decree 15402 relating to the receptacles and packing material used in the exportation of fruit (*Diario Oficial*, No 836).

Water Board in Paraguay (February 23, 1923). — Decree reorganising this body (*El Peruano*, No 82).

Peruvian Law on Stock-Hygiene (March 19, 1923). — According to this law, the importation and exportation are prohibited of all animals suffering from contagious, or hereditary, diseases and of all animals suspected of being attacked by such diseases; it also forbids the importation, or exportation,

of the products of such animals, or of any substances, or objects, that have been in contact with them (forage, litter, excrement, pieces of harness, etc.) The law defines the measures to be adopted in the case of diseases (slaughter, isolation, etc.) The executive Authorities shall institute Stations for the examination of stock, and provide bacteriological laboratories in places where animals are imported (*El Peruano*, No 75)

Order relating to Olive-Oil in Portugal (February 1923). — Order rendering compulsory the declaration of all olive oil in the possession of dealers, shopkeepers and workers *Diario do Governo* Series 1, No 41

Agricultural Syndicates in Portugal (July 24, 1923). — Decree No. 3702 authorising the Agricultural Syndicates of the region of the fine wines of the Douro to form themselves into a federation (*Diario do Governo*, Series 1, No 159)

Law relating to Thefts of Live-Stock in South Africa (June 29, 1923). — Law unifying and amending the laws in force in the different provinces of the Union relating to the theft of live-stock and of agricultural produce Under the term live-stock are included horses, donkeys, mules, bulls, cows, oxen, heifers and calves, sheep, goats and pigs, poultry, tame ostriches and preserved game (*Union Government Gazette, Extraordinary*, No 1330)

Law providing for Premiums on Cattle in South Africa (March 15, 1923). — Law providing for the payment of premiums upon butchers' beasts and beef exported overseas The Governor General may authorise the amount of these premiums being taken from the Consolidated Revenue Fund for the fiscal year ending March 31, 1924 The premiums shall be calculated at the rate of one farthing per lb (for butchers' beasts), and of one half-penny per lb (for beef) (*Government Gazette Extraordinary* No 1319)

Order relating to Locust Control in Spain (Aug. 8, 1923). — A Royal Order to the effect that the Civil Governors of Provinces invaded by locusts are to be urged to take every means to enforce the Order of the Ministry of Agriculture under date of June 19, 1923 which obliged all the local defense Committees to furnish a report concerning the land asserted to harbour locust eggs (*Gaceta de Madrid*, No 229)

State Control Centres of Agricultural Service in Spain (March 21, 1923). — Royal Order bringing to the cognizance of all whom it may concern that land ceded to the State for Centres of Agricultural Service must be regarded as State property for so long as it is the site of the above-mentioned Centres (*Gaceta de Madrid* No 82)

Commission for Cotton Cultivation in Spain (June 1, 1923). — A Royal Decree nominating a Commission for the encouragement of cotton growing and appointing a permanent executive Committee (*Gaceta de Madrid*, No 153)

Decree relating to Meadow Plants and Oil Crops in Sweden (June 8, 1923). — Royal Decree No. 191 concerning State subsidies for the encouragement of the home propagation of the seeds of meadow-plants, and the cultivation of forage-roots and oil-bearing plants (*Svensk Forfattningsamling*, No. 180-196)

Protection of Forests in Sweden (June 15, 1923). — Royal Decree No. 213 relating to the system of forest protection. (*Svensk Forfattningsamling*, No. 212-218)

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Standardisation of Cotton in the United States of America (March 4, 1923). — Law fixing official standards for cotton and enforcing their adoption in all cotton trading operations between the Confederate States and foreign countries with a view to the suppression of fraud. (*Public No.* 539. *Congress* 6 (*H R* 14 302))

Government Loans for Seed Purchase in Uruguay (April 16, 1923). — Law authorising the National Administrative Council to guarantee to the Bank of the Republic, moneys lent to agriculturists for the purchase of seed. (*Diario Oficial*, No 5110)

Special Commission for Problems of Cattle-Feeding in Uruguay (Feb. 16, 1923). — Decree entrusting the study of the problem of feeding dairy cows to a special Commission authorised to present a report on the subject. (*Diario Oficial* No 5071)

Law relating to Selected Seed in Uruguay (April 27, 1923). — Law providing that Agricultural Stations shall set apart a portion of their land for the production of selected seeds (*Diario Oficial* No 5121)

Estimation of Wealth of the Country in Uruguay (May 3, 1923). — Decree appointing a Commission for taking a census, and making a map, and estimation of the sources of revenue possessed by the country (*Diario Oficial* No 5138).

Experiment Stations and Agricultural Instruction.

Agricultural Institute of Algeria. — This Institute, which was founded on February 28, 1921, owes its existence to the transformation (in accordance with the unanimous request of the " *Assemblées Algériennes* " in the course of their session of October 1920), of the " *Ecole d'Agriculture algérienne* " established at Maison-Carrée, Algiers in 1905. The new Institute is thoroughly well equipped and possesses an efficient Staff, therefore it can collaborate to the fullest extent in research work, experimental investigation and the popularisation of agricultural knowledge. The number of students has much increased lately, 230 having been registered in the three years 1919-20-21, viz about 76 each (until 1914, the average number had been 23). These included in addition 91 students and 27 foreigners. The students are taught all that is necessary for the working and systematic management of a country property, or an agricultural industry in North Africa, and other countries of the Mediterranean basin. Many posts are open to the students on their leaving the Institute; they can start, or manage, country farms, become experts in crop-cultivation, or fill different situations in various agricultural industries (wine-making, distillation, oil-extraction, the extraction of essential oils and perfumes, the canning trade, the dairy and dairy-products industries, etc.), or can enter the several branches of agricultural engineering, or engage in trading in agricultural products.

From the very wide theoretical and practical training afforded by this Institute it may be said to rank as a general School of Colonisation. The number of Chairs has been increased and has now risen to 31. Instruction is given in the following subjects: General, special and comparative agriculture — Sugar and colonial crops — General, special, and genetic botany — Vine-growing — Arboriculture and horticulture — Animal anatomy and physiology, stock and

farm hygiene — Veterinary science — General and special stock-breeding — Entomology — Bee-keeping — Parasitology — Microbiology — Human hygiene — Elements of physics — Meteorology — Inorganic, organic, agricultural and agro-geological chemistry — Agricultural geology; the geology of Algeria — Technology — Wine-making — Elements of mathematics and of mechanics — Agricultural engineering — Agricultural hydraulics and rural buildings — Industrial electricity — Land surveying, levelling and drawing — Political and rural economy — Rural legislation — Courses in Arabic

The method of study is original, in so far as its chief characteristic is the fortunate combination of theoretical instruction (given at the Institute) and practical work carried out, at the best seasons, on the properties adjoining the Institute which cover an area of 600 hectares. A *Centre of Practical Motor-Cultivation* with workshops for repairs has been attached to the Berteaux estate (Department of Constantine) where cereals and forage-crops are grown on a large scale, and dry-farming and stock-breeding are practised. This enables the students to become accustomed to handle tractors on large areas. It should be noted that another similar and very active centre of agricultural experiment and popularisation exists where much research and trial work is done and which forms the headquarters of the following affiliated organisations: *Ecoles d'apprentis-mécaniciens, conducteurs agricoles Cours saisonniers d'œnologie, de taille et de greffage de la vigne etc* (Official communication). For further information apply to: Directeur de l'Institut Agricole d'Algérie, à Maison Carrée, Algiers.

Agricultural Education in Queensland (Australia). — An Act providing for agricultural education has recently been passed by the Federal Parliament of Queensland, the object of which is to fit boys to follow agricultural pursuits, to train girls in domestic science, and to enable the more advanced students to take degrees and diplomas in agriculture. The Act provides for the setting up of a temporary Board of Agricultural Education. Upon the recommendation of this Board, the Governor in Council may establish whole or part-time agricultural schools, day or evening classes, and hostels for the accommodation of the students. The whole annual cost, upkeep and maintenance of these schools or classes will be defrayed out of State funds. The agricultural education so provided is, with few exceptions, to be free (*The Journal of the Ministry of Agriculture*, Vol XXX, No 5, London, August 1923).

Vine-Growing Station in Austria. — Since 1922, the Federal School and Experiment Station of Viticulture and Fruit-tree Cultivation of Klostermünster, near Vienna (Austria) (former Oenological and Pomological Institute) has extended its sphere of action by the creation (under the auspices of the Ministry of Agriculture and Forests), of a Vine-growing Station which has been placed under the direction of the Inspector, Dr F. ZWEIFELT. Since its foundation, the Institute has displayed great activity in the field of hybridisation and selection and has published a report of its labours. The Institute has over 200 collaborators working for it in different parts of the country.

Courses of Agricultural Instruction instituted by the Belgian Peasants League. — The question that principally occupied the attention

of the "Boerenbond" (Peasants' League) in 1922 was agricultural teaching, especially post-school instruction. By means of courses of study for rural teachers it made every effort to spread methods likely to encourage and render profitable elementary instruction in agriculture in the primary schools. As regards post-school agricultural teaching, courses ("cours normaux") in agricultural subject were started. These were held during the holidays to enable the teaching Staffs to benefit. In the 5 provinces where the Boerenbond successfully collaborated in this work, the classes were attended by 626 teachers. In the same provinces, 258 temporary winter schools for adults were opened, 215 of which schools were under the direct management of the League and of the local Syndicates.

Experiments with Cereals at Ontario Agricultural College (Canada). — Communicated by Mr. Doherty, Canadian Correspondent at the International Institute of Agriculture

The Ontario Agricultural College has been the great factor in increasing the yield of barley, oats and winter wheat in this region.

The barley crop increased on an average 17.44 % per acre for the years 1902-1922 and this was largely due to the distribution to the farmers of the Mandschewri barley in 1892, and the O. A. C. No. 21, in 1906. The experiments made at the College during a period of thirty-three years have shown that the average yield of the Mandschewri barley has surpassed that of the common six-rowed variety by 10 bushels per acre per annum; while in a period of 17 years, the O. A. C. No. 21 has proved superior to the same variety to the extent of producing 11 bushels more per acre, per annum. The O. A. C. No. 21 is a six-rowed, bearded barley with stiff straw and white grain of good quality. For some years past, scarcely any other variety has been grown in Ontario.

The large increases observed in the oat crops is apparently due to a considerable extent to varieties introduced by the College; the Vicks' American Banner oats (now abbreviated to Banner), was imported from the State of New York in 1891. In the College tests, the Banner oats were surpassed by the Siberian, imported from Russia, by an average of 3.9 bushels per acre, per annum from 1891 to 1902, and by the O. A. C. No. 72 by an average 9.7 bushels per acre for the past 16 years.

The O. A. C. No. 72 was started at Guelph from a single seed in 1903; in comparison with Banner, it has about 2 % less hull and requires exactly the same number of days to reach maturity.

Dawson's Golden Chaff variety of winter wheat was distributed from the College to Ontario farmers for the first time in 1893; and for a long time, it has been the most extensively grown winter wheat in the Province. The O. A. C. No. 104 was originated at the College by crossing Dawson's Golden Chaff and Bulgarian. It is a heavy yielding, white wheat, without awns and with white chaff. It was distributed throughout Ontario for the first time in 1916, and is now increasing rapidly.

The distribution of seed of these varieties has necessarily been confined almost entirely to the farmers of Ontario. At present, however, they are all being grown by members of the Canadian Seed Growers' Association (with headquarters at Ottawa)

Dominion Illustration Stations at Quebec, Canada. — Under the above head, J. FIXTER explains in *The Agricultural Gazette of Canada* Vol. X, No 3, pp 212-215, Ottawa, 1923, the motives that have influenced the Government of Canada in founding the above farming demonstration Stations. He describes their work and chief object, which is briefly, to draw the attention of agriculturists to the possibility of obtaining higher yields by applying the well-attested methods adopted in the Experiment Stations.

Modern Experimental Farm to the north of Swatow, China. — The College of Agriculture, Canton, proposes to utilise this Experiment Station to train students along scientific and practical lines, especially in citrus growing, dairy farming, and sericulture. A canning factory will be started where maize, peas, beans, tomatoes and fruits will be tinned. Another branch of work will be the growing of sugar cane. A refining plant is being constructed and will be run in connection with the Farm. (*The Canton Times*, Dec 13, 1922)

The Popularisation of the Practical Sciences in Cochín-China. — The Governor of Cochín-China has decided to publish a series of popular works in order to familiarise the native population with the methods and results of modern science. The first book, which has already been published, is a pamphlet on Rinderpest, a translation will be widely circulated in the country districts. The second of the series is a treatise on tuberculosis and the prophylactic measures to be adopted against this disease. A practical account of silkworm-breeding will shortly be issued in French and in Anamite.

Sugar Industry Experiment Station in Czecho-Slovakia. — A new Experiment Station for the study of questions connected with the Sugar Industry has been opened lately at Prague.

School of Agriculture near Bordeaux (France). — A new School of Agriculture, Viticulture and Horticulture was opened in October at Blanquefort near Bordeaux. For information apply to the M Grimal (Director of the School), Blanquefort.

Central Station of Phytogenetics in France. — The "Institut des Recherches agronomiques" has been authorised by the decree of October 25, 1923, to organise a Central Station of Phytogenetics where research on the improvement of cultivated plants is to be carried out with the assistance of the Regional Stations that will be established at the request and with the co-operation of the Agricultural Offices. The Selection Associations will be entrusted with the popularisation of varieties whose merits have been duly attested.

The New Development Fund for Agricultural Instruction in Great Britain. — Under the Corn Production Acts (Repeal) Act 1921, a sum of £1,000,000 was provided for agricultural research and education. Of this sum, £850,000 was allotted to England and Wales and £150,000 to Scotland. It has been decided that in England and Wales the Fund, together with the interest upon it, shall in general be expended during the five-year period from April 1922 to March 1927.

The allocation at present contemplated is approximately as follows: — Research and Advisory Work, £465,000; Higher Agricultural Education, £84,000; County Agricultural Education, £70,000; Scholarships for the sons

and daughters of agricultural workers, £117 000; Miscellaneous Schemes, £74 000

This allocation is provisional. If on investigation the proposed schemes prove more or less expensive than anticipated some rearrangement may be necessary.

A number of grants from the Fund for research and advisory work have already been approved. These include grants for general agricultural and horticultural research, for research in dairying and fruit growing, and for research in animal and plant diseases. Grants also have been approved to extend the provision of technical advice, the investigation of local problems, and advisory work in agricultural costings. An annual grant is also to be made to enable the existing number of Research Scholarships and Travelling Fellowship to be increased.

Proposals for assisting the National Poultry Institute Scheme for the development of the poultry industry of the country have already reached an advanced stage of consideration. These plans will involve a net charge on the Fund of about £43,500. Under the scheme provision will be made for higher instruction in poultry keeping and for extensive research work.

Of the sum reserved for Higher Agricultural Education, £64 000 has been provisionally allocated for grants in aid of capital expenditure at University Departments of Agriculture and Agricultural Colleges. Part of the money has already been very successfully expended — a grant of £15 000, for example, enabled the Royal Agricultural College, Cirencester, to re-open after having been closed since 1914 owing to the War.

A grant of £70 000, spread over four years, has been made for increasing the annual grants to county authorities, this is, to enable them to extend their systems for providing instruction and advice in agricultural subjects. Assistance is also being given to the establishment of Farm Institutes.

In Section 3 of the Corn Production Acts (Repeal) Act, which established the Fund, the granting of scholarships for the sons and daughters of agricultural workers is specifically mentioned as one of the purposes to which money from the Fund should be applied. A scheme is now in operation under which the following scholarship may be awarded annually —

10 scholarships enabling the holders to take the degree course in Agriculture at certain University Departments

10 scholarships enabling the holders to take a two years' course in Agriculture at certain University Departments and Agricultural Colleges.

300 scholarships enabling the holders to attend courses of not more than one year's duration in agriculture, horticulture, dairying or poultry keeping, at Farm Institutes and similar Institutions

The total cost of the scheme is estimated at £117 000. A Central Committee, which includes representatives of University Institutions, Agricultural Colleges, County Agricultural Education Authorities, Organised Associations of Agricultural Workers, the Board of Education and the Ministry of Agriculture, has been set up to make the selections for the first two classes of scholarship, and to advise the Ministry generally on the Scheme.

The Scottish section of the Fund, which is administered by the Board of Agriculture for Scotland, is also being expended on education and research.

(*Journ. Ministry Agric.* March 1923 and *Scottish. Journ. Agric.* Oct. 1922; April 1923)

Cheshire (England) Agricultural School. — The work of this establishment includes a complete general course in Poultry breeding, incubation, rearing chicks, fowl-houses, the breeds of poultry reared, egg-production for trade, intensive poultry-farming, rearing fowls for the table, breeding ducks and geese, book-keeping, teaching poultry-breeding and the method of co-ordinating the work with that of the "Country" according to the system practised in the Cheshire Agricultural School (*Journal of the Ministry of Agriculture* Vol XXX, No 2, pp. 152-157 London, 1923).

Experimental Work in Guadeloupe. — An additional credit of 55 000 francs is to be used for the establishment of an Entomological Laboratory, Botanic and Experiment Gardens, Stock-Breeding Stations, and a Service of Information and of Propaganda.

Courses on Growing Tea and Quinine in Holland. — The Journal Official of Holland of August 28, 1923 contains the charter of a Society, with headquarters at Deventer (Holland), which has been founded with the objects of providing students who have passed through the "École moyenne d'Agriculture Coloniale", with the opportunity of specialising in the cultivation of tea and quinine. Regular courses on these subjects will be held at Deventer.

Tobacco Experiment Station in Java. — Annual Report (May 1-April 30, 1922) issued by the Experiment Station for Tobacco, in the district of Norstenlanden, published in 1923.

Selection work The second generation of the cross Ex Kanari was planted in the experiment gardens at Kaoeman. Plants to the number of 172 were reserved for seed selection. The F_3 generation was subsequently studied with great care. All the individuals had developed equally well, but a good deal of inequality was observed in the fermented product. The less satisfactory individuals of the third generation should, however, not be condemned too summarily. Some very fine individuals were obtained from the F_3 and these were reserved for seed production.

A cross was also made between "Arbre nain" and Kamari but the results obtained were not satisfactory owing in some cases, to the drought, and in others to spotted character of the tobacco produced. When cultivated in the Sorogedoo plantation, this hybrid proved superior both as regards quantity and quality (See, Mededeeling XXXIII).

Phytopathological researches — The question of *Phytophthora* control was studied. It was found that 50 % of the manure samples analysed contained spores of this fungus, and even the manure that appeared free from them proved infected. Only the unmanured plots remained healthy. There are 3 methods of controlling this disease: 1) disinfection of the manure; 2) the avoidance of dung, or night-soil, as fertilisers; and the use of chemical manures in their stead; 3) the selection of a phytophthora-resistant line of tobacco. The first method is too costly, but the second is being thoroughly studied at the Station. — Some serious cases of the disease known as "Slymdikka" have been observed.

Lasioderma, which had been a pest affecting tobacco in transit, has been overcome by scrupulous cleanliness in the sheds.

Some experiments in *rapid fermentation* have been conducted with satisfactory results at the Station but the *drying tests* carried out by heating the sheds were a failure.

Manurial Experiments — See, No. 548 of this *Review*)

Seed cleaning. — From a total of 726 kg of seed sent from the various plantations to be cleaned, 700 kg of best quality seed were obtained

The report also contains 12 circulars dispatched during the course of the year to planters who are members of the Station. The circulars give practical advice respecting the disinfection of manure and of soils, the temperature of the sheds, new materials for covering the shed-roofs etc.

(Dr A. D'ANGREMENT, *Proefstation voor Vorstenlandsche tabak* Mededeeling XLVII, pp 1-49, Buitenzorg 1923)

Agricultural Instruction under the Direction of the Lithuanian Ministry of Agriculture. — The programme of this Ministry includes agricultural education, the training of teachers to give agricultural instruction to pupils in elementary schools, improvement of live stock, and the encouragement of associations of agriculturists. The Ministry has founded agricultural courses in many districts, and in order to reach the more remote regions, travelling lecturers are largely employed. The teaching is free to all and lasts three months. In conjunction with the municipalities the Ministry is establishing district seed cleaning stations and measures are being taken for the improvement of live stock. Among other associations which are aided by the government, the Shaoli Union combines all the district agricultural associations of the northern portion of Lithuania, and is arranging the export of agricultural produce. (*The Journal of the Ministry of Agriculture*, Vol. XXX, No. 5, London, August 1923.)

Agricultural College for Mauritius. — Under the direction of the Government, the preliminary work for some time in progress in Mauritius, has resulted in the establishment of a college, which was opened in September, 1923. Students will be trained especially with a view to the development of the sugar industry, but the course extends over a wide range. In the first year, the curriculum includes the various branches of agricultural science and manual training with a general survey of tropical agriculture. The second year deals with technical application of these sciences, including also building construction, animal husbandry, veterinary science and agricultural engineering. The third year is devoted chiefly to sugar work; agricultural chemistry, sugar house control, sugar husbandry, agricultural economics and agricultural law. Special arrangements will be made for those students possessing an adequate knowledge of elementary chemistry and physics who desire to qualify as sugar house chemists, so transferring certain subjects from year to year to enable them to complete their course in two years, and entitled to a certificate in agricultural chemistry and sugar technology. An interesting feature in Years I and II is the required collection to be made by students of 24 properly named weeds and poisonous grasses and 15 common grasses, 12 specimens showing fungous and bacterial diseases and 20 insect pests of various native plants. Prizes and medals are arranged for each year's work and a "Laureateship"

or travelling scholarship for two years, open to students who have completed their course. The Principal, Dr. TEMPANY, is well known for his thorough knowledge concerning sugar questions and tropical agriculture. (*International Sugar Journal*, Vol XXV, No. 298, p. 351, 1923).

The Nappan Experimental Farm Nova Scotia. — The Nappan Dominion Experimental Farm was established in 1888 and covers 275 acres of cultivated upland, about 80 of marsh and 109 acres of rough pasture and woodland.

The work of the Station is mainly connected with live stock and field crops. Since 1910 experiments have been carried out in the improvement of the common dairy cow by the use of a pure-bred sire, Ayrshire and Holstein bulls being employed. The results obtained are worthy of note from the standpoint of the breeder. The cost of milk production was estimated for a period of nine years. The farm has a herd of Shorthorns and also one of pure-bred Guernseys. In the case of sheep, swine and poultry a series of similar grading experiments were made. As regards crops, data has been collected as to suitable rotations, cultural methods, grain mixtures and fertilisers. Last year work was started on the improvement of marsh-land by proper systems of drainage and cultivation.

Horticultural work has included the study of the best methods for the cultivation of bush fruits, vegetables, potatoes etc. and the testing of spray mixtures. (*Agricultural Gazette of Canada*, Vol X, No 3, Ottawa, 1923)

Federal Station of Viticultural Experiment at Lausanne and the Estate of Pully (Switzerland) Report of the Scientific work of the Station during 1922 :

I — *The Division of Plant Physiology and Pathology* has studied the following questions : 1) Vine-cultivation (pruning and training — choice of stocks — hybrid direct bearers) ; Diseases of the vine (phylloxera and the reconstruction of vineyards — mildew — oidium — "coitre", or hail-disease — control of vine-worms — vine apoplexy. 2) Fruit-tree growing — 4) Diseases and parasites of fruit-trees (the use of arsenical salts, viscous and band traps — fungi causing fruit rot, *Monilia* of the apricot-tree). 4) Comparative effect of poison gases upon various insects. In addition, the Station has administered the Intelligence Service and the inspection for control of diseases of cultivated plants.

II — The Division of Chemistry and Bacteriology has occupied itself with the following subjects. 1) The Intelligence Service — 2) Statistical analysis of the Swiss wines in 1922 — 3) Study of stocks (in collaboration with Division I) — 4) Reconstruction — 5) Study of direct bearers — 6) Oenological products — 7) Fungicides and insecticides — 8) Fruit-growing enquiry — 9) Tessinois vineyards — 10) Bacteriological Service (selected wine and cider yeasts) — Ripening of grapes — Processes of Wine-making and cider-manufacture, materials used, etc.

III — The work of the Secretariat includes amongst other things, the organisation of 7 courses : 1) for market-gardeners — 2) arboriculture — 3) the treatment of vine diseases — 4) the conservation of fruit and vegetables — 5) wine-making (vintage operations) — 6) wine-making (care of wines) — 7) cider-making.

IV. — On the estate of Pully, the effect exercised by different widths of spacing on the quality and quantity of the crop was studied (FAESH and TON-

DUZ P. Rapport annuel 1922. *Annuaire agricole de la Suisse*, Year 24, Part 2, pp. 75-100. Berne, 1923).

Bernese School of Dairy Industry (Switzerland) Scientific Work done during the Scholastic Year 1921-1922. — The "Bernische Molke-reisschule" (Bernese School of Dairy Industry) founded in 1887, is maintained and subsidised by the Federal Government in accordance with the law of May 28, 1921, dealing with agricultural teaching in the Canton of Berne.

It has been entrusted with the following work: a) the practical and theoretical preparation of the Staffs required in dairies and dairy industries; b) the management of a model dairy and the preparation of model dairy products. The school is further required to act as a centre of information in all matters connected with the dairy industries and also to be a Research and Experiment Station.

In order to carry out this programme, the Dairy Industry School has been provided with perfectly equipped school-building, class-rooms, and laboratories for practical work (chemistry, bacteriology, milk-testing), a technical library, teaching and demonstration collections. It also possesses a model working-dairy, a factory supplied with all the necessary appliances, pig-sties where 250 to 300 pigs are fattened on the waste products of the dairy industry, while the large School of Agriculture at Rütli where a fine herd of dairy cows is kept and also breeding-cattle and a herd of breeding-pigs, allows the students of the Dairy School to visit its premises for the purposes of observation and demonstration.

The dairy-factory handles 2000-3500 kg of milk daily which is sent from the co-operative dairies of the neighbourhood and from the Rütli School of Agriculture. Three courses are held annually at the School, two half-year courses from May 1 to the middle of October, and from November 1 to the middle of April respectively, and one 12-month's course. Students are only admitted to the half-year courses after at least two years of practical work in a dairy-factory, or dairy. The 12 months course is especially intended for technical experts of the milk industry in general. All candidates must be well educated and possessed of good general capacity.

Work done during the Scholastic Year May 1921-April 1922. — The average general fat content of the milk supplied to the School in the course of the year was 3.96 % as against 3.78 %, the general average for the 8 preceding years. This increase was due to the dryness of 1921, and the good quality of the hay consumed throughout the winter. The dry matter reached 13.00 %. The amount of milk handled in the year was 828 059 kg. of this, 385 360 kg. were made into Emmental cheese, 213 324 kg. into butter, 191 805 kg. were sold in the natural condition, while the rest was made into different types of skim-milk and soft cheeses. The yield in Emmental cheese was 9.7 % of the weight of milk (unripened cheese).

An average of 207 pigs were fattened every month, their average initial weight was 24.6 kg. while they weighed 142 kg. on an average, when slaughtered. Average increase 422 gm. live weight per head and per day. In order to produce 1 kg increase in live-weight 3.77 kg. of starch value were needed that is to say, 1 kg. of starch value produced in increase in live-weight of 0.264 kg.

The industrial types of cheese have recently had a more, or less, bitter flavour which has been attributed to the use of fermented whey but as all the

output of the factories using fermented whey is not thus affected, the phenomenon must be attributed to other causes. The Berne School has always made use of fermented whey without any ill effects, and employs small quantities as a starter in effecting the separation of the curd and obtains considerable advantage from the practice.

The work of Dr G. KOESTLER, who is attached to the Liebefeld Dairy Experiment Station, has shown that if, in the manufacture of Emmenthal cheese, any difficulty is experienced in separating the whey, 50 to 100 gm. of pure, dry, granular calcium chloride should be added. The calcium chloride is dissolved in 10 litres of water and added to the milk before coagulation takes place (*Schweizerische Milchzeitung* Nos 76, 77, 78, 1922).

In order to obtain table butter of first quality under the conditions prevailing in Switzerland, it is necessary to proceed as follows: 1) in the morning the milk should be centrifuged on arrival (the cream being separated until it forms about 15 % of the milk), 2) the cream is at once cooled down to 12° C. or lower, 3) the cream is further, and more rapidly, cooled in the evening (by plunging the vessel containing it into iced water) to 7-9° C, at which temperature a large number of granules of butter solidify which makes the whey freer of fat, 4) next morning, the cream is churned to a certain extent, but not too much.

The Bernese School has installed an Ahlborn cream ripener with a capacity of 400 litres. This apparatus is in communication with a reservoir which allows water of a given temperature to circulate between the double wall of the vessel and in the serpentine shaker. Very satisfactory results have been obtained with this machine, so that the School advocated its use in all butter factories with an output of at least 150 kg per day.

At the present time, the School is engaged in comparative experiments that will last several years, on different types of cream separators (with disks, or with outlet). The makers of the first type consider that it works more efficiently, while the second type is recommended for its greater solidity. There is little difference between the centrifugal separators turned out by the various firms. The essential portions are the same in every case, but it appears that the types with disks are preferable since they avoid the drop system and are more solid than the others. (PETER A XXXV *Jahresbericht der Bernischen Molkereischule Rützlikofen für das Rechnungsjahr 1921 und Schuljahr 1921-22*, pp. 36. Zollikhofen, Selbstverlag der Molkereischule (1922).

A New Forest Experiment Station in the United States.—The Lake States Forest Experiment Station has recently been added to those already established by the Forest Service. The headquarters of the Station will be at St. Paul, Minn., under a co-operative agreement with the Minnesota Agricultural College. This will be the Fourth Station in the eastern United States. The Michigan timber area amounts to 19 000 000 acres, of which 12 000 000 have been cut over and are generally unproductive. The primary object of the new Station will be to make these cut-over lands again productive. The Director of the Station is Dr. Raphael (Zon. *The Official Record*, United States Department of Agriculture, Vol. II, No. 38. Washington, D. C., 1923).

Congresses and Conferences.

Vth International Conference of American States. March 5-May 3 1923, at Santiago, under the Presidency of His Excellency DON ARTURO ALLESANDRI, the President of Chili, decided on the adoption of a programme of a wide-reaching character for the co-operation of the American Republics in the study of agricultural problems, uniformity of agricultural Statistics, the elimination of diseases of cattle and plants, and the interchange of useful plants and seeds. (*Bulletin of the Pan American Union*, Vol. LVII, No. 2, Washington, D. C., U. S. A.).

IVth International Pedological Conference. May 1924, at the International Institute of Agriculture, Rome. The International Pedological Committee decided at the Meeting held in Zürich in June 1923 that this Conference should cover a period of 8 days. It is proposed that an International Pedological Association should be established. Excursions will be arranged in the district of Rome and characteristic parts of Italy during and at the close of the Conference. Communications should be addressed to the Comité organisateur italien de la IV^e Conférence Internationale de Pédologie, Institut International d'Agriculture, Villa Umberto I. Rome (Italy).

International Seed Conference in London, July 1924. — The information and decisions arrived at, at the International Seed Conference held at Copenhagen in 1921 are published in book form obtainable from Dr. Volkart, Zurich (Switzerland). Price 5 francs Swiss. A European Seed Association was subsequently established. On the invitation of the British representatives, the next Conference will be held in London and Cambridge.

Vth International Olive Growing Congress at Nice, October 14-20, 1923. — The following conclusions were reached:—

1. That the VIth International Olive Growing Congress held at Nice, October 14-20 1923, congratulates the International Institute of Agriculture at Rome on having taken the initiative as regards the organisation of the International Conference at Madrid, notes the decisions arrived at during the said Conference and expresses the desire that the Governments interested should duly take into consideration the modifications considered to be necessary for each country.

2. The Congress fully recognises the extent of the valuable work effected by expert authorities in the various countries, who thanks to their work and experiments have contributed to a clear understanding as to the biology of the olive fly and the natural parasites, and in addition the artificial means of control. It was decided:

"That these theoretical and practical investigations be continued and encouraged by the States interested and by the agricultural Societies".

3. The Congress, awaiting the practical application of scientific measures for the satisfactory control of the olive fly and observations concerning the natural parasites has decided:

"That the satisfactory means of control be forthwith recommended and generally adopted.

International Congress and Exhibition of Social Economy at Buenos Aires (Argentine Republic) September 1924. — This Congress

and Exhibition will be held at Buenos Aires under the auspices of the "Museo Social Argentino", an unofficial institution in co-operation with the Argentine Government. The Congress will deal, *inter alia*, with agricultural questions, comparison of the importance of agriculture and commerce and industry in various countries, organisation of agricultural credit and of international commerce in agricultural produce, etc. — Besides delegates representing national or municipal authorities any one interested can on payment of a fee, attend the Congress. Inquiries should be addressed to the "Museo Social Argentino", Maipú 126, Buenos Aires, Argentine Republic.

The British Association for the Advancement of Science. — The Ninety-first Annual Meeting was held at Liverpool from the 12th to the 19th of September and was very largely attended. Among the Presidential addresses of special interest to readers may be mentioned the following: — "Symbiosis in Animals and Plants" (Professor G. H. H. NUTTALL), "The Present Position of Botany" (A. B. TANSLEY), "Science and the Agricultural Crisis" (Dr. L. CROWTHER). There were also important discussions on Virus Diseases of Plants, the Effect of Soil Sourness on Plants, and Farm Management and Agricultural Economics. In his highly suggestive address Dr. CROWTHER expressed the view that a general recognition of the necessity that the would-be farmer should be able to present credentials of adequate training as well as of practical experience would serve as a most powerful aid to the progress of agricultural education. Admittedly land is among the most important of natural assets, its enjoyment therefore should be allowed only to persons duly qualified to put it to effective use.

In 1924 the Association will hold its meetings in Toronto.

Imperial Botanical Conference, London, July 7, 1924. — At a representative meeting of botanists held at the Linnean Society's rooms it was decided to hold a Conference of British and Overseas botanists early next summer on the occasion of the British Empire Exhibition. It is expected that the Conference will include discussions upon modern aspects of systematic botany, ecology, morphology, plant-physiology, genetics, plant pathology, and upon the best means of effecting interchanges of students and staff between different parts of the Empire. The meetings will all be held within the week and excursions will be arranged for the week end and the beginning of the following week. (*The New Phytologist*, Vol. XXII, No. 3, London, 1923).

French Colonial Congress. — The decisions and reports relative to this Congress held under the auspices of the "Commissaire général de l'Exposition Coloniale de Marseille", have been co-ordinated and statistics brought up to date. These two volumes will serve to complete the existing set comprising two volumes with reference to the "Congrès de la Santé Publique" and of the "Prévoyance Sociale" and five volumes concerning the "Congrès de la Production Coloniale", an interesting collection of works dealing with French colonisation.

Communications should be addressed to M. le Président de l'Institut Colonial, 5, rue Noailles, Marseilles (Price of the two volumes, 25 francs, by cheque or postal order).

Tea Congress at Bandoeng, Java, June and July 1924. — Combined with an exhibition.

Coffee Congress in Java, May 1923. — Held in Malang (Java) and occupied especially with the problem of the control of "boeboek" and the comparative values of coffee cultivated alone or as a catch crop (coffee and rubber). (*Indische Mercur.* July, 20, 1923).

Pomological Congress in France, 1924. — At the Congress held in Strasbourg (September 7-8, 1923) it was decided that the forthcoming Congress for 1924 be held at Angers.

Viticultural Congress in Australia, June 1923. — The 4th Annual Congress of the Federal Council of Australian Vinegrowers was held in Sydney when it was decided to exhibit at the forthcoming British Empire Exhibition in 1924, with a view to demonstrating the quality of Australian wines. The said Exhibition proposes to offer a market for wines, which 3 or 4 years hence should reach a total of 10 000 000 gallons.

World Power Conference in London, July 1924. — In connection with the World Empire Exhibition and organised by the British Electrical Association. It is hoped that a large number of technical and scientific institutions and industrial organisations in Great Britain and other countries will take part. The aim of this Conference will be to study the most advantageous methods of utilising machine power to meet national and international requirements. From the agricultural standpoint, comparison will be made between the experiments carried out with a view to improvement in scientific agriculture, irrigation and transport.

National Milk Congress in France, June-October 1923. — (Congrès national de la Laiterie française), held at Strasbourg at the same time as the Pasteur Exhibition. The produce of model installations were exhibited. Amongst these may be mentioned the State Railway exhibit; a collection of Normandy and Charentais products which subsequently encouraged the dairy farmers of Charentes to make a special study as to the possibilities of marketing their produce in Alsace, especially butter which up till now has almost exclusively been imported from Normandy.

Exhibitions and Meetings.

International Exhibition of Milking Machines and Refrigerators at Buenos Aires, (Argentina), May 5 1924. — Under the direction of the Ministry of Agriculture. The Exhibition will be divided into 4 sections: 1) Machines and implements connected with dairy farming and treatment of milk; 2) fodder for the milch cow and methods of preparation and preservation; 3) equipment for cold storage and technical methods employed; 4) literature, pamphlets, plans, and publications in general. All exhibits will be accepted free of charge.

Communications should be addressed to the "Comité de la Exposición Internacional de Maquinaria de Lechería y Refrigeración, Ministerio de Agricultura, Paseo Colón, 974, Buenos Aires.

1st International Exhibition of Dairy Industry and Commerce at Milan, April 1-7, 1924. — Under the auspices of the Italian Government.

Amongst those invited to participate are included small producers who can exhibit only a minimum portion of their produce.

Communications should be addressed to "Comitato della Mostra dell'Industria e del Commercio caseario Milano"

International Fair, Havana (Cuba), February 9 to 24, 1924. — The first recorded Fair of its kind (Primera Feria Internacional de Muestras).

Exhibition of Agricultural Machinery in Paris. — In January 1924 in the Grand Palais des Champs Elysées Exhibits welcomed from all countries allied or associated with France during the War and to neutral countries Communications should be addressed to Commissariat Général du Salon de la Machine agricole, 8, rue Jean Goujon, Paris, 8^e

XIth Exhibition of Agricultural Machinery in Brussels, January 16 to February 25, 1923. — In the Palais du Cinquantenaire, Brussels (Belgium), under the direction of the Société de Mécanique et d'Industries agricoles Regulations and programme to be obtained from the Secrétaire, 29 rue de Spa, Brussels

Agricultural Exhibition at Prague. (Czecho-Slovakia), May 16-21, 1923. — Organised by the "Union agricole de la République tchécoslovaque", a proof of the activities in progress in this country There is no doubt that farming in Czecho-Slovakia has re-established its normal status, and overridden difficulties entailed by the War, in a comparatively short time, and is now making rapid progress

The section of the Exhibition reserved for animals such as pigs, poultry, rabbits and also for fish is worthily of special mention The horses, and cattle sections were equally encouraging

In the "Palais de l'Industrie", specimens of wheat, origin of various countries, Exhibition of the Union expérimentale agricole, of the Ministry of Agriculture, of the Conseil provincial d'Agriculture, of the Institut d'Etat pour la réforme agraire, and others; the Pomological Exhibition etc

Although nominally a National Exhibition, foreign countries were not slow in showing their interest, especially Germany and England who took part at the exhibition of Agricultural Machinery

Report of Agricultural Exhibition at, Kovno (Lithuania), September 1923. — This exhibition covered an area double that of the preceding year and the number of visitors was in proportion Some 150 trade firms were represented and out of 37 stands, 11 were occupied by foreign produce Owing to the late summer the quality of the seeds and fruits had suffered to a large extent With reference to live stock, 150 head were shown and 100 different poultry species, 90 coming from England, with the object of subsequent improvement of Lithuanian breeds. The agricultural machinery was a distinct attraction

British Empire Exhibition: Agricultural Section April-Oct. 1924. — The Ministry of Agriculture and Fisheries is co-operating with the National Farmers' Union and the National Milk Publicity Council to put before visitors to the British Empire Exhibition at Wembley Park, London (April-October 1924), a display that will convey an adequate picture of the history, progress and possibilities of land cultivation in Great Britain and Ireland. There will be a 240 ft. range of show cases containing experimental subjects

and samples of home products. Many phases of agricultural activity will be shown on the cinematograph, and some of the country's leading authorities on scientific agriculture will be present to explain the pictures and give lectures.

A completely equipped exhibition of dairy farming will be arranged by the Farmers' Union and Publicity Council. A dairy (100 ft × 70 ft) and a cowshed (30 ft × 70 ft) will be erected; 40 cows of the finest breeds will be housed in the shed and demonstrations made as to the most modern methods of milking and the dairy by-products.

Agricultural Exhibition in Adana (Turkey), May 1924. — Postponed from November 1923 in order to extend the interest

Demonstration Exhibition of Potash Salts in Alsace. — A touring demonstration-cinema-exhibition has been arranged by the "Société commerciale des potasses" in Alsace with the object of making the French farmer acquainted with fertilisers as a whole and especially with potash fertilisers. Inside the demonstration tent which measures 850 × 250 metres, the visitor assists in the preparation of the various potash fertilisers, before delivery to the farmer. This includes: both the elimination of crude salts, which after crushing and sorting give the sylvinite, and the manufacture of potassium chloride. Photographs of experimental tests on various crops are shown. A lecture is also given by an expert, and a film shows the rich mineral content of Mulhouse soil. This demonstration has already toured: la Meurthe-et-Moselle, l'Aube, la Marne, le Vaucluse and le Gard.

Agricultural and Horticultural Exhibition. Paris, February 1924. — In the Grand-Palais des Champs Elysées, Paris, organised by the Société centrale d'Aviculture, de France, and under the auspices of the Ministry of Agriculture. The exhibits will include poultry, honey, olive oil, wines, flowers, plants, fish. Communications should be addressed to the Commissariat Général, 34 rue de Lille, Paris.

Exhibition of Sugar Beet Seed at Paris, January 19-27, 1924. — At the Foire Nationale de semences to be held in the Grand-Palais des Champs Elysées, Paris. Communications should be addressed to M. Saillard, 34 rue du Louvre, Paris.

National Seed Fair, Paris, January 19-27, 1924. — In the Grand-Palais des Champs Elysées, Paris, under the direction of the Office agricole départemental de la Seine. This is arranged simultaneously with the Salon de la Machine agricole. Communications should be addressed to M. E. Rousset, Directeur des Services agricoles de la Seine, Commissaire Général de la Foire, 63 rue de Varenne, Paris.

IVth National Seed Fair at Chartres (France) October 1-13, 1923. — Held in the Place des Halles, 15, Chartres; the exhibits include wheat, oats, winter barley, rye, etc. It may be noted that the first seed Fair was organised by the Office agricole d'Eure-et-Loir, in 1920 in collaboration with the "Syndicat agricole de Chartres". The transactions made at the Fairs held in 1920, 1921 and 1922 amounted to 8000, 12,000 and 18,000 quintals respectively and the Office agricole d'Eure-et-Loir has decided to continue the organisation of Seed Fairs as much in the autumn as in the spring. For a complete report on the proceeding see *Journal d'Agriculture pratique*, vol. II, No. 45, p. 370. Paris, 1923.

Competition for the best Wheat Grower in France. — The object of this competition organised by "*Le Matin*" is to encourage the farmer to judge and criticise, and to put new energy and interest into the cultivation of wheat along lines similar to those followed by the "Offices agricoles départementaux" and the professional Associations. Prizes will be awarded by the selected judges. Competitors are expected to exhibit to the said committee the wheat crop as a whole at a date as near as possible to the harvest. The "Offices agricoles" will be held responsible in each district for the direction and control of this competition.

Exhibition of Hops from Flanders (October 14-November 1923). — Under the auspices of the Agricultural Society in the district of Hazelbruck. (Department du Nord, France).

Horticultural Exhibition, Paris, October 6-November 4. — Cours-La-Reine, under the direction of the Société nationale d'Horticulture de France. The vine produce took the first place. The 1st "Grand prix d'honneur" was presented to M. Salomon of Thomery (Seine-et-Marne), for table grapes. This is the first time since the Society was established that the prize has been awarded for fruit.

Horticultural Exhibition at Nice (France), March 6-10, 1924. — Under the direction of the Société d'Horticulture pratique de Nice et des Alpes-Maritimes. In addition has been arranged an exhibition of wines and olive oil.

Lavender Fair in France. — Held at Dignes (Department of Basses-Alpes) on October 6th 1923, with the idea of establishing a market for lavender perfumes. Address: Office agricole des Basses-Alpes, 9 rue du Colonel Payan, Digne (Basses-Alpes).

Imperial Fruit Show at Manchester (England), October 26th to November 3rd 1923. — At the Belle View Gardens, Manchester. Address of Secretary: 18 Bedford Square. London W. C. I.

Competition of Agricultural Tractors for Army Use in France. — The "Commission centrale militaire" under the direction of General Wilmet, General Inspector of Automobile equipment, has organised a series of tests starting on October 8th 1923, at Satory to compare the relative durability of agricultural tractors likely to benefit by the subventions of the Ministry of War. Four machines have been selected: light tractors, Ara, and Citroën-Kégresse; medium, Citroën-Kégresse; heavy tractor, Renault. The tests were made near Versailles, until October 20, using successively, petrol, benzol and carburetted alcohol (50 % benzol). Prizes were awarded to the owners of these machines.

Exhibition of Equipment for the Artificial Drying of Fruits and Vegetables, at Toulon (France), September 27th-30th 1923. — For further information, communications should be addressed to the General Secretary of the Société d'agriculture, d'horticulture et d'acclimatation du Var. 5 Place d'Armes, Toulon.

Exhibition in the Dutch East Indies, of New Zealand Products. — Travelling exhibition in the principal towns of Java and neighbourhood, due to commence in September 1923.

Exhibition of Natural Products and Materials in Bolivia, December 19 1923. — At Ciudad, Bolivia.

Franco-Danish Exhibition of Foods at Copenhagen (Denmark), September 15, 1923. — Under the auspices of the Comité Français des Expositions. Further information may be obtained from M. Alfred Bertrand-Taquet 42, rue du Louvre, Paris.

Exhibition of Russian Products at Berlin, November 2, 1923. — At No 130-132, Alte Jacobstrasse, Berlin, S. W. exhibits including timber, tobacco, wheat, hemp wool, etc

British Industries Fair, April 28-may 9 1924. — Postponed from February 1924, in London and till the following Monday in Birmingham (Agricultural Machinery, etc)

Exhibition-Ship. — A ship has been fitted up in France to serve as a travelling exhibition of French products arranged to voyage for 7 months, calling at all the chief ports in South America The ship is provided by the Under secretary of the "Marine marchande"

Information may be obtained from the "Fédération du Petit Armement", 161 rue Montmartre, Paris (*Journal d'Agriculture pratique*, April 18, 1923).

Miscellaneous.

The Sugar-Cane and Sugar-Cane Industry in Brazil. — Communicated by the Delegate of Brazil to the International Institute of Agriculture.

The sugar-cane is the object of special study at the Campos Agricultural Experiment Station of which the author is the Director Already numerous seedlings have been obtained, these are distinguished from the Cuban plants by writing the letter C after, instead of before, their number

In Brazil, as in all other sugar-producing countries, the sugar-industry has for some years been passing through a crisis The author is trying to induce the Brazilian sugar-makers to co-operate with the cane-growers in such a manner that the latter may share in the profits of the manufacturers in proportion to the amount of sugar-cane supplied and its sugar content The chief part of this little pamphlet is occupied by a petition addressed to the President of the Brazilian Republic in which are set forth the need of agricultural credit and co-operation In the Appendix, Dr P BIGLER describes a "scheme for a Central Institute of Industrial Chemistry to be founded at Campos" (*A Industria Assucareira Campista em 1922*, Rio de Janeiro, Papellaria Americana, 1922)

The Navel Orange in Brazil. — In the State of Bahia of which it is a native, the navel orange is now cultivated to supply the market at Cabula, Brotas, Barras, near the town of Bahia, and especially at Catù, Alagoinhas, Villa Nova, Serrinhas, and at Jacobina in the interior of the State. The author gives the names of the largest growers. Fine navel oranges readily fetch 10 or 20 milreis (paid to the producer) per hundred. (*Laranja de Un'ibigo na Bahia. Chacaras e Quintões*, vol. XXVII, No. 6, p 516. São Paulo 1923)

Pine-Apple Cultivation in Tonkin. — Pine-apple growing has extended considerably in Tonkin, especially in the Province of Quang-Yen, in Doug-Trien and along the Phu-Lang-Thuong-Langson railway. Pine-apples thrive in hilly districts which are unsuited to rice The Tonkin fruit is much inferior

to the famous pine-apple of Singapore, but there is no reason (according to the *Éveil Économique*) why it should not become as good, or even better, than its rival. Its improvement would create an important canning and preserve industry (*Annales de l'Institut Colonial de Bordeaux* July-August 1923)

Stock raising in the State of Amazon (Brazil). — M. Nunes Pereira, who occupies the position of "Assistencia veterinaria" as "Delegado Interno do Serviço de Industria Pastoril", has undertaken the collection of data relative to stock raising in the Basin of the R. Amazon which amounts to more than 34,700 head. This number has shown a rapid increase in spite of divers difficulties (especially the lack of highways), but these are compensated for to a large extent by the favourable conditions for stock as regards both climate and soil, and the healthy nature of certain rural districts. (*Brazil-Ferro-carril*, Year XIV, vol XXV, No 316, pp 461-462. Rio de Janeiro, 1923))

Forest Fires in Norway (Communicated by M Fjelstad, Delegate of Norway at the International Institute of Agriculture) — The question of insurance against forest fires aroused general interest in Norway about 1890. The Ministry of Agriculture of that date drew up statistics of forest fires and a Royal Commission recommended that the "Norges Brandkasse" (official Bank of insurance against fires in general) should undertake to issue forest-fire insurance policies, this, however, was not done until 1911. In 1912, the Insurance Company *Del norske gjensidige skogbrand forsikringsselskab* was founded. During the ten years 1901-1911, over 5000 hectares of forest were destroyed of which 1660 hectares were burnt in the year, 1911.

Since 1893, Norway has possessed some legislation for the protection of forests against fire. The existing measures have been amended during the course of years and especially by the law of July 2, 1921 which unified the legislative code making it the same for the whole country and defined the means for prevention of forest fires, and of fighting a fire and limiting its spread, after having broken out. One of the best means of limiting the extension of such fires is by the construction of *Forest-Fire Guard Stations*. At the present time, each forestry district possesses one of these Stations, connected by telephone with the nearest centre. The telephone Service is in operation night and day, including Sundays. There are 40 Stations of this kind.

The Norwegian Mutual Society for Insurance against Forest Fires was founded by private initiative. Every owner of a forest (private, or communal, official, or semi-official), is allowed to insure all property. There are no shareholders. All the profits are paid into a reserve fund which is administered in such a manner that the premiums are fixed, and low. The direct object of the Society is to cover by a mutual system any loss caused to its members, while at the same time, it tries to prevent the occurrence of forest fires. The Society compensates its members for the injury done to the soil and for the loss incurred by premature felling. The owner is left to decide to what extent he wishes to insure his forest. As regards the stands to be insured, it should be mentioned that in a large number of Norwegian forests, a *regulation for the exploitation of forests* has been introduced ("*Skogvedtekter*") which fixes the minimum size which trees must reach before they are felled; this is gener-

ally 5 m. in height and 17 cm. in diameter (but in special cases may be 5 m. in height and 15 cm. in diameter).

All persons interested in fixing the amount of the insurance policies and in the payment of compensation after a fire, are requested to apply directly to the Society, of which the headquarters is at Christiana; prompt replies will be sent to all communications.

Extending Electric Service to the Farms in U. S. A. — The practical difficulties of farm electrification are many as farms are often so widely separated as to make economical electric service impracticable. This and many other allied problems are now being studied by a committee of representatives of the U. S. Department of Agriculture, American Farm Bureau Federation, American Society of Agricultural Engineers and the National Electric Light Association. (*Wallace's Farmer*, Vol. 48, No. 41, p. 1386. Des Moines, Iowa, 1923)

Irrigation Work in India. — At Sukkur in the Province of Sind, on October 24, SIR GEORGE LLOYD, the retiring Governor of Bombay, laid the foundation stone of what will be the largest barrage in the world. The barrage will feed seven canals, three of which will be wider than the Suez Canal and one will have a discharge equal to that of the Thames. The total area of land included in the scheme amounts to 7 500 000 acres of which 6 500 000 are cultivatable; this exceeds the total cultivated area of Egypt. The estimated outlay on the project amounts to more than £12,000,000 sterling. (*Nature*, Vol. 11, No. 2819, November 1923)

The Exports of Senegal Gums. — The export of gums from Senegal and Mauritania shipped from the port of St Louis has risen during the last ten years from 1500 to 4500 tons, an increase of 3000 tons. This is a matter of considerable importance because of the high prices fetched at present by these products (4,500 fr per ton on an average). Since 1919, the shipments have been between 4000 and 5000 tons. These gums, sandarac, gum arabic, euphorbia gum, etc) come from both banks of the Lower Senegal, Timbuctoo, the French Sudan, and the territory of Mauretania which lies between Senegal and the Moroccan Sahara.

Condensed Milk in Great-Britain. — The Food Investigation Board of the Department of Scientific and Industrial Research has issued Special Report No 13, under the title of "Studies in Sweetened and Unsweetened (evaporated) Condensed Milk" The Report has been prepared by the Canned Foods Committee of the Food Investigation Board and deals chiefly with the bacteriological problems involved in the successful condensation and canning of milk. (*The Board of Trade Journal*, No. 1389, 1923).

The Worlds' Production of Eggs. — The United States have broken the record for egg-production. There are in that country, 233832546 hens, which are said to have laid 14 620 000 000 eggs, but if the number of eggs produced by each fowl is taken into account, it is by no means large, being only 64 Germany registers 52 270 000 fowls and 4 590 000 000 eggs, with an average of 82 eggs per hen. England possesses 25 120 000 hens laying 2 125 000 000 eggs, average 86 per hen, France has 15 million hens, Denmark has 14 055 000 hens producing 935 000 000 eggs, average per hen 84, and Belgium possesses 5 030 000 hens laying 510 000 000 eggs; average per hen 92 eggs.

The Use of Low Temperatures in Transport (France). — The series of agricultural publications brought out by the "Compagnie des Chemins de Fer Paris-Lyon-Méditerranée" (France) has lately received an addition in the form of a pamphlet entitled "Practical Advice on the Use of Low Temperatures in the Transport and Storage of Perishable Articles of Food" ("Conseils pratiques sur l'emploi du froid dans le transport et l'entreposage des denrées périssables") by H. LÉMOIR. There are 2 300 isothermic and refrigerating cars at the disposal of the perishable food industry in France. This pamphlet is written for the purpose of propaganda. After describing the cars, the author gives detailed advice as to their selection and use according to the nature of the goods (meat, butter, eggs, vegetables, beverages, etc.) and the season of transport. Another part of the pamphlet is devoted to setting forth the manner in which cold-storage warehouses can be used for various articles of food.

Locust Invasion (Algeria). — (Communicated by the "Inspection de la Défense des Cultures" of the Government General of Algeria) In May and June 1923, a very large centre of "Sauterelles pèlerines" (*Schistocerca galeata*) was reported as existing on the borders of Tripolitania, at Tarat (100 km. east of the Polignac Forest) which in 1924 might prove the point of departure for swarms taking part in a serious invasion of Algeria.

The Control of the "formiga saúva" (*Atta sexdens* T.) in Brasil. — The "Sociedade Fluminense de Agricultura e Industrias Rurais" of Nictheroy (State of Rio de Janeiro), organised in September 1913, a competition for the purpose of testing, by means of public experiments, the efficiency of the chemical, mechanical, chemico-mechanical, or other means used for the destruction of the "formiga saúva" which at present constitutes one of the most formidable pests of Brazilian agriculture.

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